

# CROSSTALK



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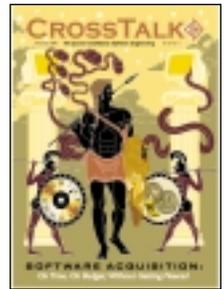
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*On Time, On Budget, Without Getting Fleeced*

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**On the Cover:** Kent Bingham, Digital Illustration and Design, is a self-taught graphic artist/designer and freelances print and Web design projects. His portfolio is at [www.adobe.com/eportfolio/kentbingham](http://www.adobe.com/eportfolio/kentbingham).

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**CrossTalk would like to welcome new Associate Publisher Elizabeth Starrett, formerly of the Air Force's TaskView Development Team.**

## CrossTalk

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**Coming Events:** We often list conferences, seminars, symposiums, etc. that are of interest to our readers. There is no fee for this service, but we must receive the information at least 90 days before registration. Send an announcement to the CROSS TALK Editorial Department.

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**Back Issues Available:** The STSC sometimes has extra copies of back issues of CROSS TALK available free of charge.

**The Software Technology Support Center** was established at Ogden Air Logistics Center (AFMC) by Headquarters U.S. Air Force to help Air Force software organizations identify, evaluate, and adopt technologies to improve the quality of their software products, efficiency in producing them, and their ability to accurately predict the cost and schedule of their delivery.

## Quality Leadership Is the Foundation for Successful Reform



This CROSS TALK issue highlights two interviews with the leaders of major weapon systems programs at Eglin Air Force Base. The success of the Advanced Medium Range Air-to-Air Missile (AMRAAM) and Joint Air-to-Surface Standoff Missile (JASSM) programs can be found in a 30 percent or better reduction in purchase price, and a projected reduction in lifetime ownership cost. Acquisition reform is credited with their success. But what I saw was enthusiastic leadership and vision committed to an achievable goal. AMRAAM Director Judy Stokley and JASSM Manager Terry Little are champions of acquisition reform, but I saw that their ability to lead, coupled with the freedom to make decisions, would bring them success under any label. Their vision combined with an ability to communicate with supporting staff created cooperation among government employees and a partnership with contractors. Acquisition reform in the hands of good leaders eliminates the traditional adversarial relationship between contractor and government, and replaces it with an environment of trust in which problems can be efficiently resolved and goals achieved.

The JASSM success began by placing great emphasis on evaluating contractors' past performance. More effort was expended in evaluating past performance than in the source selection process. Once the contractor was selected both AMRAAM and JASSM government personnel directed their energy to helping the contractor succeed instead of overseeing his activities. Contractors were not told how to do their job, but they were held accountable for the results, and warranties were expected and obtained for the final product. In a pre-acquisition reform environment Stokley cited an example of government always tasking the contractor to do the wrong thing, like measuring turn-around time during repair functions when the real goal was availability. When the contractor became a partner and was asked how to improve availability, the answer was simple. "Stop measuring turn-around time, and grade them on availability," she said. Not too surprisingly when the right goal was measured, it was achieved.

This issue also has an important message by Kristen J. Baldwin for acquisition programs. Baldwin leads a Tri-Service Assessment Initiative instituted by the Office of the Under Secretary of Defense for Acquisition. The initiative's primary objective is assisting Department of Defense program managers by providing a comprehensive review of their programs. Risks are identified and recommendations are made to mitigate those risks. Participation is voluntary and results are strictly program oriented. This initiative is inclusive and goes beyond the software boundaries into hardware and program issues. The Software Technology Support Center has participated as assessment members in these reviews, and we find them beneficial.

Evaluating the contractor's ability to perform is a common theme among acquisition organizations. The Army approached this challenge by developing a Process Risk Evaluation (PRE) tool. PRE is based on the Capability Maturity Model® and helps choose a winning bidder in the source selection process. To learn more read *Evaluating Risk in Competitive Procurements*, by Timothy Carrico, Jeffrey Herman, Linda Blades, Mary Slagle, and Dennis O'Connor

This issue also contains an article from the Navy on Independent Verification and Validation (IV&V). It provides a methodology for writing an IV&V plan based on the Institute of Electrical Engineers' standards, and updated as a result of three U. S. Navy project iterations. For more information read *Writing an Effective IV&V Plan*, by Dan F. Walters. We hope that you find this issue of CROSS TALK useful, and we welcome your comments and contributions.



Reuel S. Alder  
Publisher



# Judy Stokley and Terry Little Lead Acquisition Reform

AMRAAM, JASSM program directors dramatically cut costs, increase performance.

Pamela Bowers, Managing Editor

Two Air Force missile programs are bringing in a new era of acquisition reform that is providing the United States and allied war fighters with better and lower cost weapons. The heart of these programs is a more commercial business arrangement with the government and a single prime contractor in each case.

The first is the Advanced Medium Range Air-to-Air Missile (AMRAAM) program. It will yield an estimated life-cycle cost savings of more than \$590 million from streamlined business practices, and optimized and significantly reduced government and contractor manpower, according to Judy A. Stokley, member of the Senior Executive Service, director of the Air-to-Air Joint Systems Program Office (SPO) Air Armament Center at Eglin Air Force Base in Florida.

Prior to 1997, AMRAAM was a "Super SPO" manned with 325 government and support contractor people. Business was conducted the traditional way with intensive oversight of two competing contractors producing AMRAAM missiles and associated support equipment. Then in 1998 a buyout resulted in a single prime contractor, Raytheon in Boston, Mass., accepting Total System Performance Responsibilities (TSPR) with the government defining its enabling roles.

Another pioneer in the Department of Defense's (DoD) acquisition reform and streamlining efforts is Terry Little, program manager for the Joint Air-to-Surface Standoff Missile (JASSM) program. Little has incorporated numerous reforms in the JASSM development effort, and with its prime contractor, Lockheed Martin Missiles and Fire Control, Orlando, Fla., is dramatically reducing cost and acquisition schedules. He says current projections peg the unit cost of the missile near \$300,000, compared with an original threshold cost of \$700,000, and \$1.6 million for its predecessor, the Tri-Service Standoff Attack Missile (TSSAM).

Little notes that the government will save more than \$960 million (in 1995 dollars) in fixed costs over JASSM's production period. This is possible he says, because instead of mandating countless military specifications, the JASSM program has just three key performance parameters: range, missile mission effectiveness, and carrier operability. All other requirements are tradable to keep costs down, he says.

Both government programs also boast of acquiring a bumper-to-bumper lifetime repair warranty on the missiles.

To understand more completely the acquisition reform measures Stokley and Little have initiated, CROSS TALK recently interviewed these two pioneers at Eglin Air Force Base. Following is a condensed version of their comments. For full comments see [www.stsc.hill.af.mil](http://www.stsc.hill.af.mil) ◆



The AIM-120 Advanced Medium Range Air-to-Air Missile is a new generation air-to-air missile produced under a new era of acquisition reform saving more than \$590 million.

**CrossTalk:** How has acquisition reform shaped the acquisition strategy on your program? What impact has it had on product cost, schedule, and performance?

**Stokley:** When AMRAMM was established in the late 1970s, we brought on two competitive producers, then Hughes in Tucson, Ariz. and Raytheon in Boston, Mass. At the time we were in the cold war, and we planned a procurement strategy that was based on the Air Force and Navy buying 24,000 missiles in 10 years. When I came back to the program in 1997, the plan was then for them to buy a little over 10,000 missiles in 21 years. So the acquisition strategy needed to change completely because we had two full-up producers and factories, the government controlled all of the more than 370 specifications, and we mandated a build-to-print package to each of those contractors. They were in head-to-head price competition each year to build the missiles.

We began to discuss with the two contractors how to split the work to increase efficiency. Coincidentally, Raytheon decided to buy Hughes. When they did that, we had the real opportunity to set up a team business structure and partnership, and a long-term pricing agreement with Raytheon. Once one producer was responsible for the product, we were able to divest a lot of the

cross checking and government control, and allow Raytheon to assume total system performance responsibility (TSPR).

We wanted to save significant dollars out of every unit's procurement cost ... and simultaneously shift more of our appropriated dollars to buying missiles as opposed to buying overhead. And we wanted to significantly reduce the size of the government workforce required to execute the program.

In a year and a half we accomplished those three initial goals, and established a business framework that would last for the life-cycle of the program. We wanted to save 25 percent of average unit cost. We actually saved 30 percent. Then we rolled some of that back into investments, one of which was software modernization. We were also able to reduce our workforce by two-thirds.

**Little:** It [JASSM] has shaped the entire acquisition reform program. We have found it necessary to use entirely different than normal processes in order to achieve our goals. First of all we picked contractors based on past performance. In our case, past performance was equal to price and missile performance combined. We did not ask the contractor to provide us any description of his processes. We merely looked at his performance on recent relevant activities that were similar to ours in those spe-

cific areas that we felt were important to our program.

Next, we essentially redefined the government's role: to establish the requirements, select the contractor, and work interfaces that are outside of the contractor's control. There is no function that we have assumed for oversight, other than what I exercise and the procurement contracting officer. Their [government employees] responsibility is to make the contractor successful as a player.

The other thing we did is we have no processes required in our contract. It is strictly a performance specification. So we do not care how they do what they do, as long as they meet the performance requirements.

The end result is we are right now projecting it will be under the objective of \$400,000 per unit. Our schedule is going to be about seven years, which is about 60 percent of what it has taken historically to do this, and the performance is equal to and some respects better than the predecessor program.

**CrossTalk:** What impact have the changes had on the way your software acquisition organization does business?

**Stokley:** We simultaneously looked at this program in two ways: the near-term problem, which was having two vendors, and too much infrastructure cost. We also wanted to set up the program for long-term performance gains for war fighters. One of the things we decided needed to be done was to modernize the processors used in the missile and to modernize its software.

The software was still in Hughes-specific assembly code, and the processors were Hughes-specific. Long term we felt it was important to move to a commercial processor so that there would be common processor architectures and people who could work with those architectures across the site. We received approval to reprogram part of our savings back into the program to convert to a Motorola 750. Raytheon is converting part [not all] of the software to C++ that has to be changed when we upgrade the system for electronic countermeasures.

The cost to upgrade the AMRAAM processor and re-host the current software in a commercial high order language is \$20 million with a projected payback of \$62 million dollars. This payback comes from two sources: lower Preplanned Product Improvement (P3I) phase 3 costs (\$12 million), and lower software development costs (\$50 million) achieved over the 15-year life cycle of the missile.

**Little:** Our contractor has TSPR. We have a warranty. Our role is to do the things the contractor cannot do, or that we can do better. Essentially it is [our job] to help him succeed.

In general, what the government engineer brings to the table is a broader experience than what your typical contractor has. In our case, it may come from working on other weapons systems programs where there are some lessons learned. In the case of JASSM, we have some people who worked on its predecessor program Tri-Service Standoff Attack Missile. In the software area, the processes and lessons learned are pretty codified. The government does not particularly have anything to add, and I have no dedicated software people in my organization. That seems to be working since Lockheed is doing quite well in the software area.

**CrossTalk:** Describe the business arrangement between government and contractor. How are various platform interfaces managed?



"... we do not buy software. We buy a well nurtured missile system that has software in it ..."

"We gave him [contractor] control of the hardware below the missile performance specification ... some 370 specifications ... he is now free to make those decisions as long as he meets performance ... warranty, and ... price."

—Judy Stokley, director, AMRAAM, Eglin AFB

**Stokley:** First of all both [original] contractors already gave the government a 10 year bumper-to-bumper warranty. In key business shifts, we got away from annual pricing and established a long-term pricing agreement with Raytheon.

Now, what did the contractor get? We gave him control of the hardware below the missile performance specification. Previously the government controlled some 370 specifications that required a fairly lengthy government review approval cycle to change. He [contractor] is now free to make those decisions as long as he meets performance, continues to give us this warranty, and gives us the product at this price. The contractor can build off common hardware or common vendors with other products, which allows him to get some economic buys.

A second thing we gave him is self-oversight. He does his own verification testing and signs a compliance form when he sells the product to us. We do not have government quality inspectors on the floor. He does his own quality inspections and uses his own processes to ensure the quality of the product.

Lastly, we have a full and open partnership. We work with him to look at his books and financial health. We try to ensure we make smart business decisions together so he stays healthy. He looks at our government financial reporting, obligations, and expenditures to ensure that we keep our [contractor's] billing up and do not lose money. We formed an international business team with him so Raytheon gets to be part of our government team working with international companies to sell missiles.

**Little:** We have a contract, of course, but the contract does not define the relationship. It is kind of a constitution or a charter. The details of the relationship are defined by how you behave day to day. It is a very, very close team relationship characterized by collaboration, trust, full openness, quick illumination of disruptive influences, and open transmission of information. There is nothing I know, or that I think I know, or suspect that Lockheed does not know. That kind of open, honest communication has gone a long way in helping us work through problems that inevitably occur in any development program.

One of the things I have done with the government team is I have tried to destroy individuals' focus on their functional stovepipe. For example, it is unacceptable to me for a contracts

person to say, 'The contract is my problem and as long as the contract's all right, I have done my job.' That is not the way teams operate. The team must operate to an overall goal—that in our case includes schedule, system performance, life cycle costs, profit for Lockheed and its suppliers, as well as being a pioneering acquisition reform program.



"I am concerned with product, not process ... We looked at [contractor] past performance ... we have no processes required in our contract."

—Terry Little, program manager  
JASSM, Eglin AFB

Regarding interfaces, I have an entire integration team. Essentially it is one person per aircraft whose job it is to work the interface between that aircraft and our missile. Lockheed has a parallel arrangement with the aircraft and subcontractor. In the end the team produces an interface control document that everyone signs and adheres to.

**CrossTalk:** What other ways has acquisition reform enabled a reduction in the cost per product?

**Stokley:** There were three areas that allowed us to save a very large number of government work force. One, we eliminated cross checking and duplication where we used to do independent analyses to check the contractor. We got rid of all official data managers and all official configuration control managers. Because we do not control those 370 specs, we do not have all the data and reports. Instead, the contractor does this, and always had to anyway. If they are at the plant, my enablers will sit in on his configuration control boards as a part of his work activities. My folks are not there to check the contractor. They are there as co-workers and facilitators.

**Little:** The first [JASSM] systems off the production lines will be under \$400,000—unlike the old theory that if we produce enough of these, costs will finally go down. Our results are not only due to up-front planning but also up-front effort. During the program's preliminary design and risk reduction phase we spent as much time and more money on manufacturing risk reduction as we did on performance risk reduction. Second is price-based acquisition. The contractor offered us a very attractive price for the first five production lots. He has the ability to make any change that he wants at any time without the government's OK—so long as it does not affect performance. He has the right to put in something that may lower his cost to produce the missile, but he must pay for it. We have no provisions for value engineering change proposals.

Furthermore ... when we decide to negotiate a fair and reasonable price for additional lots, we are not going to look at what his costs are. We are going to look at how his price compares to the price for similar missiles in the world marketplace. As long as we get a price equal to or better than similar missiles, we are happy.

**CrossTalk:** Do you feel there is a business case for Software Process Improvement?

**Stokley:** Not as a stand-alone item. First of all we do not buy software. We buy a well nurtured missile system that has software in it and includes: support equipment in the field, analyses of flight tests that fold back into production and repair lines, a warranty, and high reliability. So I think of buying a missile system. I do not think of buying software or hardware.

I think of process improvement more as an attitude that we motivate industry to take to keep this a healthy viable product that meets its requirements and is affordable. I have great worry and trepidation about singling out any one element of a program and doing process improvement on it. I think the parts of the program are so interdependent that it is easy to optimize one thing at the expense of something else, often unintentionally.

**Little:** No, I am concerned with product, not processes. I am also no fan of government or third party process or capability evaluation as a way of predicting future performance. During the JASSM source selection we evaluated the offerers' past performance in software development as we did on my previous program, the Joint Direct Attack Munition. In both cases Lockheed got very good grades from their customers on the timeliness and quality of their software developments. They also performed admirably in the work we gave them. I think, in retrospect, that their great performance was due to superb execution of processes that were only moderately mature. I have no problem with that. We have no software processes required in our contract. Lockheed has to meet a performance specification and a schedule; I do not care how they do it.

**CrossTalk:** What are the most significant lessons that have been learned under acquisition reform?

**Stokley:** Historically what the government has always measured for contractors who are doing the repair work is turn time. How long does it take the contractor to repair each unit? When we asked the contractor, given that we want 90 percent or better availability of all the missiles we bought worldwide, 'how can we get there?' he said, 'Well, quit measuring turn time—grade me on availability. Let me decide how I run these units through the repair line.' So if 90 percent of them can go out in three days, and they need two months on one of them, we do not penalize them for the one that needs longer. It also allows them to take over sparing. So we changed contracts to manage availability and have been at 92 percent to 95 percent availability since.

Second ... getting a certified price package normally takes about three to six months. We knew we needed to get the contract awarded on time, so we actually briefed the auditors and asked them to come do this in parallel with us. Instead of the contractor preparing the package and handing it over to government, everybody went and lived at Raytheon. We turned around the whole thing in 30 days and awarded the contract on schedule. It was the first big thing the team did together. It really showed them that they could overcome barriers, and the people bonded quite well during that.

Third ... the program had suffered a budget cut in develop-

ment; it was considerably behind in expenditures. So I went to my counterpart at Raytheon and told him it [budget cut] was because he was behind in his expenditures. He said he never knew what those were used for. After all those years of working with the government, our AMRAAM team did not know how the Planning Programming and Budgeting System (PPBS) works. So I asked my financial manager to prepare a PPBS tutorial and go out and brief the company [Raytheon] at all levels. Since then we have been green in every appropriation from 1998 through 2000. It is the first time in AMRAAM's history that we have not lost a single dollar to budget cuts.

**Little:** When I came on to the program ... we had essentially done no preparations for milestones; the mandate was to award a contract in seven months. The team at the time said there was no way to do that in under a year. I told my folks we have one objective, and that is to award a contract in seven months, or we are all out of it. About three hours later people returned and said there was no way it could be done. I told them [on Tuesday] that on Friday, I wanted them to tell me what they were going to do—and they did. They said they were not going to do the traditional process. They wanted to do oral proposals, use past performance instead of lengthy process descriptions, and focus on things really important to the program. We did it and awarded a contract in six months. A lot of the things in acquisition reform will come when people perceive there is urgency.

Second, when we utilized past performance, a lot of people argued that we would have a protest; that it would be too subjective. In fact, we did have a protest, and it was a lot of work. It went to the General Accounting Office, but it was not sustained.

**CrossTalk:** Is there room for further acquisition improvement?

**Stokley:** Yes. Historically we have acquired a very large amount of government-furnished equipment over the two plus decades of the program. We are trying to whittle away at that and decide if we still need it, because some of it is very old. And of course someone is tracking it and paying for storing it somewhere.

Second, for government-furnished equipment that is still useful to the program, how do we streamline its management and accountabilities? We would like to transfer as much of it as possible to Raytheon's control since most of it is used in their testing and analysis processes.

Third we are still interested in doing price-based vs. cost-based procurement when we let our next long-term pricing agreement for 2002 through 2007 buys. We are exploring opportunities to use the warfighters' price requirement as documented in the Operational Requirements Document, as well as our factory-price model and our data from our cost as an independent variable exercise on Phase 3 P3I to justify price-based procurement.

We would still like to see a lot of streamlining in the international sales market and more use of direct commercial sales. I have a foreign military sales office here ... I contract with Raytheon on behalf of the [foreign] countries. One of my rules of life is "very seldom is the middle man a good thing," because every place you send money through, they will get some small share. But thus far Raytheon has not been allowed to conduct direct sales to many foreign countries.

Lastly, I would really like to see expansion of real acquisition reform across all services and all programs. It is very difficult for our industry to really grow and prosper as a result of acquisition reform if it is not implemented across a plant site.

**Little:** First, more widespread use of price-based acquisition. Second, more use of past performance in lieu of process descriptions. I know companies typically use proposal writers who know all the buzz words to put in a proposal about software processes, but these words say nothing about the company's ability to actually do software development or control software schedule. Past performance, while not perfect, is the best indicator we have for future performance. Third, we need to break down the barriers that preclude predominantly commercial companies from doing defense software.

The biggest problem we have in software is not a software process maturity process; it is the ability of the predominant defense companies to find or retain highly qualified software engineering people. As a solution to this problem, I would like to see our defense prime contractors look at subcontracting some or all of their software development to commercial companies with a proven track record like Computer Associates, Microsoft, or Oracle. Right now this would be difficult because we have barriers that would preclude defense contractors from going to commercial companies for development—barriers like cost accounting systems and others associated with the way we do business. ♦

**Judy A. Stokley** is the program director of the Air-to-Air Joint Systems Program Office, Air Armament Center (Air Force Materiel Command), Eglin Air Force Base, Fla. She leads a large extended team of civilian and military personnel, as well as several major defense companies, in delivery of critical systems to the warfighters. Stokley began her Air Force career in 1979 as a mathematician in the Armament Laboratory and, subsequently, worked in development planning and system program offices. She has a bachelor's (University of Alabama) and a master's (University of West Florida) degree in mathematics. In 1991 she graduated from the Defense Systems Management College at Fort Belvoir, Va., and in 1993 was approved for membership in the Air Force Acquisition Corps. In 1999 she was promoted into the Senior Executive Service.

**Terry R. Little** has been the program director for the Joint Air-to-Surface Standoff Missile Joint Program Office since 1996 and has more than 15 years of experience as a system program director for major programs. Previously he was the program director for the Joint Direct Attack Munition Program Office. Little entered the Air Force in 1967 and was a distinguished graduate of Officers Training School. Before becoming a civilian employee in 1975, he served on active duty as an aircraft maintenance officer, a computer systems design engineer, and an acquisition program manager. As a civilian employee he has been an operations research analyst, a program director for a classified project, a deputy program director and a weapons development planning manager. Little has a bachelor's degree in mathematics (University of Texas), a bachelor's degree in English (Southern Methodist University), a master's degree in systems analysis (Air Force Institute of Technology School of Engineering), and a master's degree in business administration (University of West Florida).

## Additional Comments from the Stokley/Little Interview

During her interview with CrossTalk, Judy Stokley, AMRAAM director, also addressed the following questions.

**CrossTalk:** What were your three main goals of Vision 2000? How successful were they?

**Stokley:** We wanted to save significant dollars from every procurement cost. At the time, we had a lot of infrastructure cost in the program so the unit cost was quite high. This was because the quantities had decreased significantly, as had happened with all systems after the fall of the Berlin wall, and the Department of Defense budget changed. We wanted to drop that [cost] down and, second, simultaneously shift more of our appropriated dollars to buying missiles as opposed to buying overhead. Third, we wanted to significantly reduce the size of the government workforce as required to execute the program. In about a year and a half we accomplished those three initial goals. We also tried to establish a business framework that would last for the lifecycle of the program. We wanted to save 25 percent of average unit cost. We actually saved 30 percent. Then we rolled some of that back into some investments, one of which was in the software area. And within one year we were also able to reduce our workforce by two-thirds. So we met our initial goals very quickly, and set up this long-term business strategy that is working quite well.

**CrossTalk:** How do you check contractor quality, or is it a complete trust relationship?

**Stokley:** It's both. First of all we use the insight of government engineers who live with the contractor working with his engineering force who are doing the design and upgrade work. The second way we track quality is through testing. There are more than 100 AMRAAMS fired each year by various test agencies, primarily field operators who shoot the missile down with what is called the Weapons System Evaluation Program at Tindle. As far as quality in manufacturing on the floor, although we're out there with the contractor all the time, we don't do any government cross-checking of his product.

**CrossTalk:** Do you see contractors using more off-the-shelf software?

**Stokley:** I think he does it, but I don't think he invests a lot of his own money to go out and search for commercial applications. The one thing, since our system undergoes such significant environmental challenges on airplanes, including vibrations, acoustics, heat, and cold, it requires a significant search for a lot of change to commercial parts. So unless it just turns out that there is something that comes along, I don't think that there's a big shift. After all, we're not in original development where you go out searching for the parts, we already have them along with established vendors.

**CrossTalk:** How do you determine what the contractor's financial health should be?

**Stokley:** That's a bigger picture question. How did we come up with all these things to do under the Vision 2000 business structure so there is benefit to the contractor and benefit to us? There are four tenants in Vision 2000. First, it is a win-win business strategy. We look at things and acknowledge what is the right

thing to do. Then, how do we make it work for both the government and the contractor. The third tenant is teamwork and trust. Fourth is that the contractor has full system performance responsibility. He has control of capability for his product.

Now how did we come up with all this vision and business structure that make this thing work together? It is really quite interdependent, and yet part of the puzzle. We realized that when we began analyzing the program in 1996 that cost had gotten out of control. We had way too many government people and were not getting enough product. Then when Raytheon purchased Hughs, we went through a somewhat traditional approach to identifying as a team with Raytheon our vision, our objectives, and what would enable us to achieve these objectives. Things like self oversight and open financial books came out in this environment. Raytheon trusted us enough to explain how they are graded within their corporation regarding profit margins. I opened up to them what my budget process is and what briefings I take to congressional staffers. So we really opened up our worlds to each other. We defined how we would reach this Vision 2000.

We have continued our off-sights together, using one facilitator now for three years. We do two off-sights a year. One is to establish that year's specific goals and objectives. A second evaluates where we are that year and identifies any problems or barriers, and also identify places to improve next year when we set our goals. It is a continual ongoing process that requires quite a bit of nurturing. You don't just set a business relationship, walk away and let it execute itself. It is not static. We're always working together identifying how to make this work better and what has changed in our environment.

For example, when we established Vision 2000 we were only authorized to sell the AIM-120 B missiles to our international customers. A big change this year is that we were approved to sell the AIM-120 C a later block configuration. So that changes the business mix of our unit. Now we want to go out and visit all these countries and offer them the missiles. So one of the things we did this year was form a new international team to go out and brief 19 countries around the world on this new missile product.

**CrossTalk:** Did these additional international sales contribute to decreasing per copy cost of AMRAAM along with the other measures you mentioned earlier?

**Stokley:** The way we did that is our savings were calculated on a base FMS quantity. As you know, FMS quantities can be quite volatile year to year. We set a pricing model around that so we're able to price the product plus or minus certain quantities. Depending on how many we sell we get a better price or more expensive price. We were quite fortunate since we had very good pricing model for changes in quantity based on historical data. We sized the program on U.S. production then modified costs up or down as our FMS goes up or down.

**CrossTalk:** Did the maintenance concept and warranty cut back significantly on deliverables that you typically see in a government contract such as software test reports and thus contribute to the savings?

**Stokley:** The contractor had always been the repair agency for the missile. We never had an organic depot. And we have had the 10-

year warranty for a number of years. We did do some streamlining in sustainment, but I don't want you to think that's the only reason we have all those no CETRALS (?) We have almost no data items on this product. We don't get any reports, other than a safety report. We have an electronic data repository that both the contractor and we can access, which we use for all reporting and monitoring processes.

**CrossTalk:** Is the jury still out on ACT reform? As systems get into maintenance and sustainment phase, do we know that it will be successful?

**Stokley:** We used JDAM very successfully in Kosovo, which had been developed following acquisition reform business practices. So I think we have seen in a few cases that you can certainly deliver a good product that works under this regime. We haven't had any of those business practices in place for 20 years, so we can't certainly say they are proven for that time. My own view is that what we know about human nature in business motivations is that the less you fragment work and clearly identify who is accountable in name and cost, then the better results you'll get.

When we get companies under ACT reform to truly be accountable for long-term price and warranty, it is difficult for me to see how that can be less than a good thing. I think it is much better than the way we used to do business, which was to fragment the work so much that it was hard to determine who was accountable for the end product. I think you'll see things improve in the areas where we have fully implemented it.

**CrossTalk:** Does a higher level of process maturity allow the contractor to provide a better product and instill confidence?

**Stokley:** In my experience I have managed several major activities that were very software intensive. I think you're talking about the Software Engineering Institute's (SEI) levels of certification. And I've been through all that process. I believe that the SEI level certification is a very poor measurement of how well they [contractors] perform. It's an exercise that makes everybody feel good. But I've not seen that it is very indicative of how different teams within the company really work.

You can go into a company that is certified at Level 3, and on your particular program they can have a terrible situation for software development. And you can walk across the hall to another program that will be on track with very good metrics, structure and flow-down requirements, verification processes, and be writing test cases ahead of time. Why? The company is Level 3; the same functional office approves both groups.

So I think this certification thing is at best some really aggregate level indicator. But I would never rely on it as an indicator of how my team is going to perform. What's important to me is not what level the company has achieved, but how my team's performing. What I look for is a good flow down of requirements, a good structure to identify the work and that it is being accomplished, and a clear verification process to determine that the work is correct. I wouldn't choose or turn down a contractor based on whether he was Level 2, Level 3 or Sigma 6.

**CrossTalk:** How do you choose a contractor to open your entire books and life to knowing it will work?

**Stokley:** I have worked with basically every major company in this country: Boeing, Lockheed, Martin Marietta, Raytheon, and numerous small companies including Marvin, Alliance, Chamberlain. So far I have not ever been treated unfairly or unethically. And I've never felt that I was treated in any way dishonestly. I always go in believing that companies are in the defense business to make a profit; and also, because they have some views about patriotism and doing what's right for our country. So far I have not been disappointed. I have always gone into my work with other government agencies and industry believing that if I'm honest and straightforward with them, they will be with me. And whatever happens, I'll get better results than if I had tried the opposite approach. If someone isn't going to work well with you they're sure not going to work better because you're hiding your motivations and your data.

That isn't to say it's trouble free, that me and my counterparts don't debate sometimes. Debate is healthy. Sometimes I have to give, and sometimes they have to give. Chuck Anderson is my counterpart at Raytheon now. He and I communicate this to our team by saying debate is OK, disagreement's OK. We want to talk about it and figure out the right approach. We always ask first, 'What is the right thing to do for the war fighters and the tax payers?' Once we define that, we'll get to who's going to pay for it.

The very last thing we ever do if figure out if it's under a contract somewhere. I never look at my contracts, and I don't expect my industry partner to be off reading his. We should be deciding what's the right thing to do, and who can afford to pay for it. We'll pool our resources however necessary to get the right thing. If we can't do the right thing for the war fighter and tax payer, and it's just way too expensive in this case, then we're going to put our story together, go up the system, and say, 'Here's some things we can do and some things we can't do.' So far that's worked. So I just don't have that fear. And it troubles me that so many people seem to have this fear.

**CrossTalk:** How do you use your government people?

**Stokley:** Government people handle several really important things that I don't think we can expect industry to take on. One is working with combat pilots to establish their operational requirements. Then they translating those into missile performance specifications. We serve as the bridge between industry and our war fighters. The government technicians have to get enough understanding from the contractor to know what's possible with technology. Then obtain enough understanding of the war fighter's capability to build this bridge that flows from requirements to specifications.

Their second job ... is we facilitate and manage the interfaces with a variety of government agencies, one being aircraft program offices and aircraft contractors. We try as much as possible to get major fighter manufacturers to work together on interface management. Remember the weapon and the two airplanes have different budget line items. So we're constantly trying to ensure that with our different budgets and requirements the weapons are going to be properly integrated and fielded so they work properly when they hit the field together.

Third we handle a lot of field activities including safety for

field, product and test ranges, and environmental requirements at different bases where the missile is stored and used including other countries. Interface management that requires a technical knowledge on both sides is a lot of what my folks work on.

Lastly, since we do launch a large number of missiles annually—well over 100—a lot of coordination is required to get all the data from those missile shots to Raytheon. There are classification issues, depending on airplane and test programs, and questions about who controls the data. We need to understand what the scenario was and what the war fighter was trying to achieve then get the data to Raytheon so they can analyze the shot. An important part of Raytheon's job is to monitor the performance of fielded missiles and ensure that if any corrections need to be made, that gets folded back into the development and repair line.

**CrossTalk:** What are the most important factors to look at when beginning a project that indicate which contractor will provide the most opportunity to succeed?

**Stokley:** The first thing to look at is past performance. Under ACT reform we made our past performance evaluations as program directors mean something. Today we have this neat line that says, 'If I were going to award a contract in the future, I would, probably would, probably would not, would not, award again to this contractor.' The only person allowed to check one and put their name on it is the program director. It means something when program directors write it down. We take how we do past performance evaluations a lot more seriously now so that they have become more useful.

Second is to get a grip on evaluating the contractor's motives. 'What is the corporation's real commitment to this product?' 'Is this one of many this year, or is this a really important thing to them?' 'Are they going to go the extra mile?' 'What is their motivation?'

## During his interview with CrossTalk, Terry Little, JASSM program manager, also addressed the following questions.

**CrossTalk:** How do you measure contractor performance and stay alert to foreseeable problems?

**Little:** We incorporate incremental testing throughout the program, including ground testing, hardware-in-the-loop testing, captive testing, and ultimately flight testing. Plus, we are committed to having an early production representative system. We are able to look at component deliveries and assess where we are.

One of the dramatic things we did differently is that our program is front-end loaded in terms of funding and effort. We have spent 70 percent of our total development budget, and we have yet to have our first flight test. We focused on maturing the system, so that when we actually got to flight testing, we would not be testing a prototype that would still have to undergo manufacturing development and continued refinement.

It's called "concurrent engineering," which is taught in software engineering schools and as a program management course. It's just that nobody ever does it because the pressure on schedule and money causes everything to be pushed out except those

things directly related to testing. The end result is that a lot of programs are back-end loaded causing a lot of changes to the system. This makes for a very long schedule, and a very difficult transition to production. In our case, factory people using factory processes, and the same for our supplier parts, produce our very first development units in the factory.

By the way, we have had absolutely no problems with software. We are ahead of schedule in a fairly formidable program. It involves not just the missile's operational flight program, but the seeker algorithms. With these the seeker finds its own target and is able to compare what it sees to what it thinks it ought to see.

**CrossTalk:** Do you attribute your lack of software problems to choosing contractors based on their past performance?

**Little:** We begin with good software requirement definitions up front based on missile performance requirements. Then we have a posture here that after defining the initial requirements, there are no changes until or unless we go through a very bureaucratic requirements control working group. I'm not talking about user requirements necessarily, but the kind of program requirements that come from some one's interpretation of the contract or what some engineer decides might be a better thing to do or not to do. We don't change anything unless we know its impact to the program and we are willing to accept that impact. So we maintain a very, very stringent control of the requirements.

When legitimate requirement changes arise, such as upgrades in the software area or additional capabilities, we use a block change approach. That means we'll do the change and we're willing to pay for it, but it's not going in the first systems; and it's not part of our development. There is a very deliberate evolutionary approach, but we're not trying to do everything at once to satisfy everyone.

My own experience is that a lot of upgrades and changes come from people who are not really day-to-day users, but who look at what might be possible then theorize a use situation. When you do that without any financial accountability, you end up with continuing requirements coming to the top. My own view is that once the system gets out in the field, the real impetus to change, upgrade, or alter the performance will come from the day-to-day users.

**CrossTalk:** Has part of managing software development been to get your requirements process under control, whether you've followed CMMI or not?

**Little:** Yes, but that doesn't have anything to do with the contractor per se though. We've gotten it under control because we've tied a financial accountability to changes. We have a situation in our business where users establish and change requirements and for the most part don't assume financial accountability for that. What we've done with this requirements control working group is that we've essentially created a situation where people have to confront the financial and schedule implications of changes. Your willingness to change when you have to pay for it is always going to be different than it is when you don't have to pay for it.

What the contractor has from us is performance requirements for the overall system. He's the one that allocates the software, hardware, and mission planning. There is absolutely no government involvement in allocation.

**CrossTalk:** Is the government team nonexistent in the software model?

**Little:** Yes. We do have government people who are part of interface control working groups. These groups create an interface document that consists of the mechanical, electrical, and logical interface for each aircraft that uses the missile. Once that document is signed, it is a commitment on both our parts, and the aircraft parts, to develop to that specified interface.

**CrossTalk:** How do you measure contractors' past performance? Are you looking at the contractor's past work or talking to his clients?

**Little:** Initially we ask each of the bidders to provide recent, relevant performance in several different areas, including cost schedule, aircraft integration, software development, and production support. In each area contractors provide three recent contracts that they think are most related to the job we're bidding. Then we negotiated with them on their choices because they have a natural tendency to want to pick and choose ones where they thought they would have good performance. Then we defined what we wanted to look at specifically. In software development it was functionality and scheduling. We asked contractors to assess these, then we went to their customers for each of these. You essentially have to develop an algorithm where you can compare contractor performance not in a general case, but in software performance that is most analogous to what you're doing. It worked great for us.

**CrossTalk:** Who conducted the analysis, government people?

**Little:** Yes. But you don't need software government people to do this. It's a matter of, 'Did you do what you said you would do?' They were all technical people. The lead of the entire past performance evaluation was a software person, my chief engineer. But that was not planned.

**CrossTalk:** What parameters in software development were used to rate past performance?

**Little:** Essentially functionality, that is, 'Did it do what you said it was going to do at the start—a promise made a promise kept? And did you meet the schedule that was laid out?' For comparison purposes, we also had to incorporate implicit weighting to balance context. The other thing we did, after we picked the two contractors based on price and missile performance was to have each contractor work for a period of time to evaluate production, price, and performance. 'What did you say you were going to do here vs. what you actually did?'

**CrossTalk:** Do you feel the jury is still out on acquisition reform?

**Little:** There are a lot of people in the department who want to say the jury is still out, or even that it's failed. Maybe most people. I don't believe the jury is out. We have three good examples of acquisition reform programs. The results are going to continue to be dramatically different from previous programs. I believe the primary reason our systems take so long and cost so much has to do with how the government does business. It is not what the systems are, but how we have chosen to buy them.

# Help Identify and Manage Software and Program Risk

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*The Tri-Service Assessment Initiative was instituted by the Office of the Under Secretary of Defense (OUSD) for Acquisition, Technology and Logistics (AT&L) in 1999 to provide Department of Defense (DoD) program managers with independent and objective software and system assessments in order to improve software-intensive systems as a whole. The goal of the initiative is to provide expertise to help program managers identify and manage both software and program risk. Each assessment is tailored to the program manager's issues, acquisition strategy, and upcoming milestones. The initiative is executed by the services who each have a senior representative on the initiative's management board. Based upon generic (i.e. not attributable to specific programs) systemic issues found across the assessments, software acquisition recommendations are made in the areas of policy, education and training.*

The Tri-Service Assessment Initiative was instituted to provide an independent, objective review and analysis of software processes, product development, and integration. Numerous cost overruns, schedule slippages and performance issues motivated the focus on software. The goal of the initiative is to provide direct assistance to program managers as well as gain visibility over recurring issues that impact software-intensive systems acquisition.

The initiative's primary objective is to provide assistance to DoD program managers (PMs). Independent assessment teams provide a comprehensive review of the programs, identify risks, and make recommendations for management and risk mitigation. Participation in the initiative is strictly voluntary; PMs must request an assessment, and the reports are limited to distribution only upon approval of the PM. The team and the PM jointly establish assessment scope and initial issue areas.

An equally important objective is to utilize what is learned from assessments to assist software intensive systems as a whole. Based upon generic, systemic issues found across the assessments, the initiative provides feedback to DoD and to senior acquisition managers, identifying issues in areas of policy, education, and training.

To accomplish these objectives, the initiative maximizes opportunities for leveraging and collaborating across DoD, government agencies, federally funded research and development centers (FFRDCs), and industry to utilize the widespread skills, experience, tools, and techniques. This is a key feature.

As a direct result of the assessments conducted to date (19 since inception), PMs are implementing relatively low-cost post-assessment recommendations and realizing high returns. Former Deputy PM of the Army's Crusader Self-Propelled Howitzer Program Kevin Fahey agreed that the initiative has been beneficial. As is the case with many large-scale programs, Crusader has been through several assessments, and Fahey stated that, "Tri-Service [Assessment Initiative] for the most part was probably the best because they focused on solutions instead of just the challenges. They did an outstanding job. They reconfirmed what we had to focus on. They gave us a lot of good ideas and places to look, people to use, tools to use."

## Sponsorship

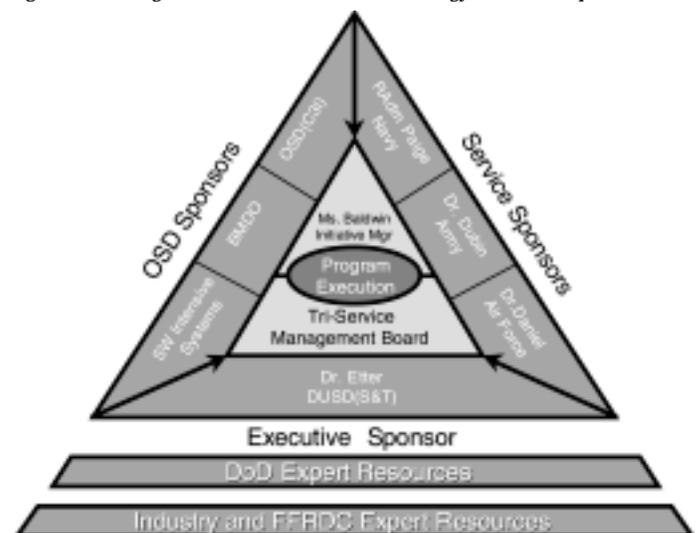
In May 2000, Deputy Under Secretary of Defense, Science and Technology (S&T), Dr. Delores Etter, assumed sponsorship of the Tri-Service Assessment Initiative. This was the result of a Defense Science Board recommendation to the Under Secretary

of Defense (AT&L) Dr. Jacques Gansler emphasizing the value of independent assessments performed for PMs in which they would retain the data. Thus results are used directly by the PM, rather than as a reporting mechanism.

Dr. Etter, seeing this as a key element of her mission to oversee and improve software-intensive systems acquisition, incorporated the Tri-Service Assessment Initiative into her Software Intensive Systems Directorate to fulfill this recommendation. Office of the Secretary of Defense (OSD) sponsorship of the initiative offers several critical advantages. First, it maintains a joint-service nature, promoting assessments as a service to any PM in DoD. Second, the initiative builds upon Dr. Etter's efforts to establish a collaborative environment of DoD software expertise. Thus, participation on the assessment teams leverages the expertise across the DoD community. Finally, OSD sponsorship promotes the initiative's systemic issue analyses, which provide valuable lessons learned to improve DoD policy, education and training.

The assessment initiative is service-executed and is overseen by a Tri-Service management board. The service executive agent is the U.S. Army's Tank Automotive-Armaments Command, Armament Research, Development and Engineering Center. Each service is represented on the management board, along with members from the Office of the Assistant Secretary of Defense for Command, Control, Communications and Intelligence, OUSD (AT&L) Systems Engineering and ODUSD (S&T) Software Intensive Systems. The totality of organizations involved as sponsors, executors and resource providers is shown in Figure 1.

Figure 1. Oversight structure ensures focused strategy, effective implementation.



The initiative manager (IM) manages day-to-day operations and implementation of the initiative, from strategic coordination and planning to tactical-level assessment execution and logistics. OSD sponsors promote the initiative by providing funding and endorsement; and gain insights into the emerging non-program attributed systemic lessons learned. The service sponsors advocate the use of the assessments within their respective services, and help the IM identify programs that can benefit from and participate in the initiative. The service sponsors also help set strategic direction and work to implement enterprise level recommendations.

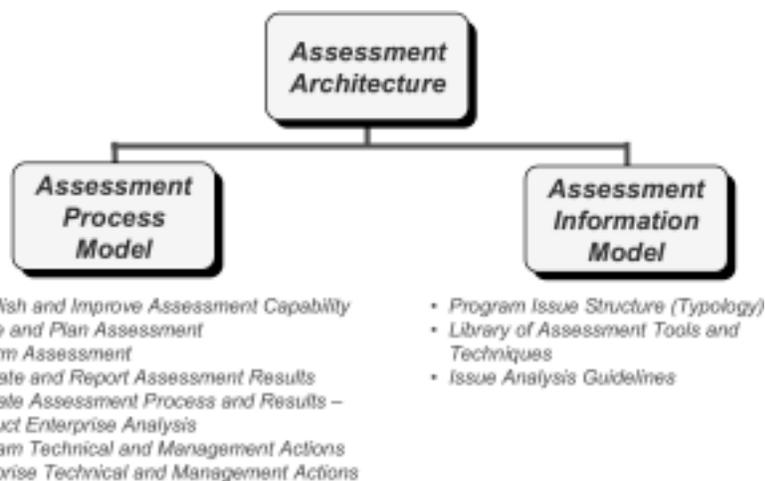
The IM selects assessment team members on a program-by-program basis by carefully matching the program-unique issues to the appropriate skills and expertise available in a nationwide resource pool composed of organizations within DoD, other federal agencies, FFRDCs, and industry (see Figure 2).

### Process and Methodology

To ensure consistent application of the assessment process, the initiative developed an assessment architecture. It is called an architecture because it provides an integrated structure that ties *existing* software and systems assessment tools and techniques together into a comprehensive assessment methodology.

The assessment architecture has two components as shown in Figure 3: the Assessment Process Model and the Assessment Information Model. The process model describes tasks, products, and responsibilities for each of the seven activities of the assessment process. The

Figure 3. *The Assessment Initiative is based on the process model and the information model.*



### Where Do We Come From?

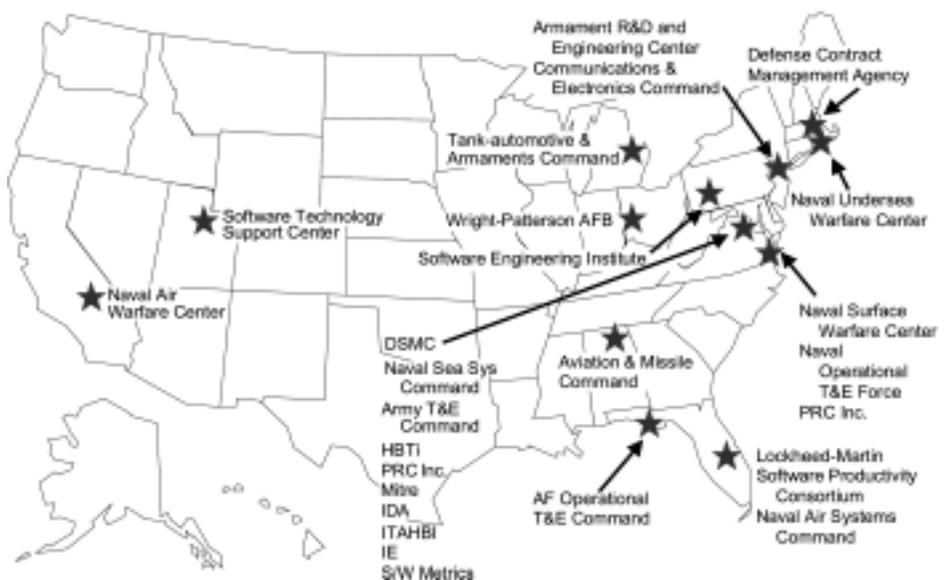


Figure 2. *Assessment team members come from diverse organizations with specialized areas of expertise.*

three core program assessment activities are: initiate and plan assessment, perform assessment, and integrate and report assessment results.

The assessment's span, on average, is a two- to three-month timeframe that begins by meeting with the PM to scope and strategize the assessment and understand his concerns. The selected team then meets to review program information and assessment strategy, and understand their individual roles. The conduct of the assessment will normally involve site visits with the program office, contractor(s), and other involved organizations as necessary, depending on the assessment scope. The assessment is focused to be as nondisruptive as possible to the program while still obtaining the needed information. The team meets with key individuals at each location to discuss

the program and review available artifacts. Minimal preparation is required from organizations being assessed with the exception of assisting the assessment team with logistics, such as scheduling interviews, reserving conference rooms, etc.

The assessment team members sign nondisclosure agreements and stress open communications with the customer and their developer locations. Discussions held during the site visits are not attributed so that issues reported are not tied to individuals. At the end of the site visit, the assessment team conducts an exit briefing to discuss initial observations and provide an opportunity for feedback in the event that something was missed or misunderstood.

The team then reviews and analyzes the data, relates the findings within and across the issues, determines program strengths and risks, and formulates program recommendations. The PM receives and reviews a draft version of the report. Additionally, the initiative provides an independent peer reviewer. Final briefings are provided to the PM to ensure the findings and recommendations are understood. The IM or assessment leader delivers the report directly and solely to the PM.

The second volume of the architecture is the Assessment Information Model, which contains an issue-based menu that guides the team through an assessment of 10 different programmatic and technical issues. The model provides a consistent baseline for identifying, assessing, and correlating program issues and strengths. The

issues deliberately encompass not only software issue areas, but also programmatic areas. The assessment teams found that software issues are, more often than not, traceable to larger, more systemic program issues such as a lack of engineering inspection, poor requirements management, inadequate functional requirements mapping, and shortcutting or eliminating software processes to accommodate unrealistic schedules. The 10 primary issue areas, described briefly below, help ensure that the assessments are performed consistently, are repeatable, and have considered all the varied aspects of a program. The assessment issue structure includes:

**Environment** What is the regulatory, labor, reform, and political environment in which the program operates?

**Mission Requirements** How complex is the development? Can it defeat the threat arrayed against it? Is the operational requirement reasonable? Does the developer have the expertise, plant, and equipment to successfully develop the required system? What are the critical dependencies between other systems?

**Financial** Is funding sufficient, timely, and stable? Is there enough flexibility in funds management to deal with program issues?

**Resources** Do the PM and the developer have the personnel, facilities, tools, and training to complete successful development?

**Management** Do the PM and the developer have the capability to plan, resource, control, and monitor the effort? This includes the acquisition strategy, project planning, contracting and subcontracting, and communication processes.

**Technical Process** Does the developer possess the capability to implement the technical processes needed to manage and conduct the development and ensure process conformance? Is that process appropriate? Is it applied to the program?

**Technical Product** How well do the products and services being produced conform to the requirement? This issue considers product lines, testing requirements, quality, human factors, and safety.

**Schedule** Is the schedule realistic? Does the schedule reflect resource usage and availability? Does the schedule track progress and dependencies?

**User/Customer** Is the end user or cus-

tomers of the product appropriately supported? This issue includes customer satisfaction and new equipment training or transition support.

**Project Specific** Are there any project-unique issues that cannot be mapped into one of the previous nine issue areas?

Although the initial focus of the assessments was software, the initiative is undergoing an expansion to encompass a total systems perspective. The issue areas lend themselves to this expansion. PMs have repeatedly asked that systems issues be investigated in the assessments.

For example, one program requested the team evaluate the human factors that technologies applied in their program. Another asked for a specific focus on simulation-based acquisition and guidance on its implementation. Yet another has requested review and assistance with communication and interoperability issues.

Interoperability and integration of multiple software systems into one platform is a common stumbling block for programs. The expansion of the initiative into the systems realm was also pursued to encompass these interoperability issues. The initiative is now used to perform assessments across programs such as within a program executive office or across a weapon system domain.

Rear Adm. Kathleen Paige, assistant secretary of the Navy (Research, Development and Acquisition), chief engineer, has overseen the implementation of the Tri-Service Assessment Initiative across several of the programs within the Navy. She says, "It is important to have specialist teams take a high-level systems look at some of our Naval programs and identify areas that need attention, especially in the area of software. Additionally, the Navy and the

Marine Corps are taking advantage of this DoD capability to look not only at individual programs, but also at the issues that arise because of the critical interfaces between these programs."

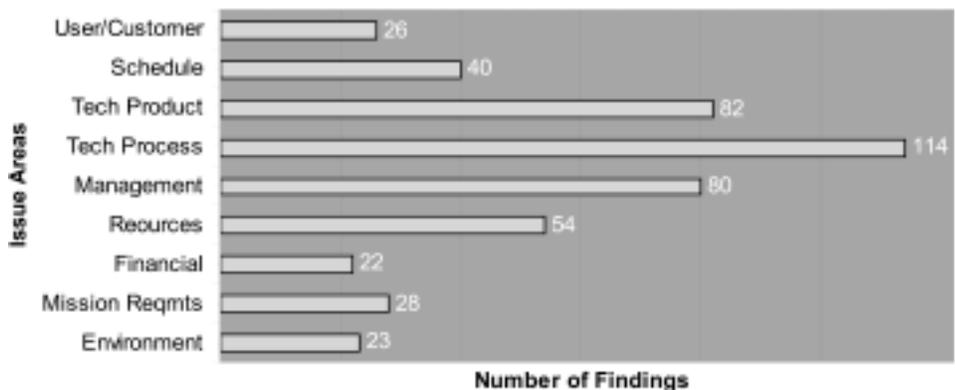
## Assessment Results and Systemic Findings

As part of the lessons learned analysis, findings are mapped against each of the ten issue areas. The mapping is a "one-to-many" relationship since often the observed effects stem from multiple causes. For example, in a program that consistently misses milestones, an assessment team may find that the developer had difficulty adequately staffing the development, the program manager had trouble obtaining sustained and adequate funds, and the program team (both government and contractor) had no documented requirements management process. This "missed milestones" finding is related to the schedule, technical process, management, resources, and financial issue areas.

Figure 4 shows the collective distribution of findings for the 19 assessments conducted to date. The number to the right of the bar indicates the number of findings mapped to the issue area.

Some of the technical process findings seen in almost every assessment are in the area of requirements management (traceability, definition, and volatility) and testing (inadequate functionality testing, incomplete test plans, and requirements that are not testable). Test findings also related to the technical product issue area as well. Without adequate testing, a product's goodness (e.g. completeness, supportability, reliability, quality) remains largely unknown.

Figure 4. *Distribution of Findings*



In the management issue area, programs suffer from a lack of communication among the acquirer, developer management, and development engineers. Furthermore, decision-making roles, relationships, and responsibilities are not well understood by team members.

The findings-issues mapping is the foundation for analyzing and understanding the systemic issues that impact program success across the services. The initiative will continue to analyze the systemic issues to better understand cause-and-effect relationships between development and acquisition issues. By doing so, the initiative can continue to more precisely formulate program-level and enterprise-level recommendations that positively impact program success as well as acquisition policy, education, and training.

## Leveraging Existing Tools and Expertise

What is the difference between these assessments and software process assessments like the Capability Maturity Model® (CMM)? Whereas CMM evaluations focus more on the capability of an organization to establish and follow processes, the goal of an initiative assessment is to determine the actual performance and health of a program, and to make specific recommendations that will allow the program to achieve its planned goals and milestones. While initiative assessment recommendations may fall in the area of software process improvement, they can also focus on systems integration, acquisition strategy, resource management, and technology. Assessment teams can use the existing process assessment tools like those related to the CMM to assess a program's process capability if that is the focus.

Another difference is in the timing and the focus of the assessments on the specific program needs. Col. Patrick O'Reilly, PM of Theater High Altitude Area Defense (THAAD) commented, "Not only was the software assessment team's assessment critical to augmenting the IV&V contractor's and project office's risk assessment, the timing of the [assessment] was critical. The assessment provided insight and advice that was incorporated into the THAAD engineering, manufacturing, and development phase request for proposals resulting in a much lower risk contract proposal."

In consonance with Dr. Etter's goal to establish a collaborative environment, the initiative is continually strengthening its partnership with organizations and agencies such as the Software Technology Support Center (STSC) and the Defense Systems Management College (DSMC). These and similar organizations can benefit from the initiative as well as provide support, expertise and a venue to convey systemic lessons learned. The STSC is providing support through expertise on the program assessment teams, and assistance in the lessons learned analysis. The initiative is partnering with DSMC to insert future lessons learned into DoD-level acquisition education. DSMC also plans to support the initiative by making tools available to assessment teams and by participating on assessment teams. To provide the initiative a way to continually update its assessment model, the initiative plans to use DSMC's Executive Program Managers Course as a vehicle to identify problems and issues encountered in the acquisition community.

Similarly, collaboration with industry has expanded; one area is based upon prime contractors expressing interest in par-

ticipating on assessment teams. Assessment teams normally consist of a team leader and members with appropriate skill mixes for the particular program, including domain experience and a PM representative. The initiative will experiment with augmenting the assessment teams with a member of the prime contractor team(s). Contractor representatives would be selected not from the specific development site, but from a different site or corporate element. These important and experienced representatives have a vested interest in program success and may spearhead implementation of team recommendations. They can also provide another perspective to the assessment process that helps to balance the information being obtained and evaluated.

If you are interested in requesting an assessment or providing your expertise on the teams, please contact us. ♦

## Note

1. The *project specific* issue area does not appear in the figure because all assessment findings to date have been adequately covered by the other nine issue areas. Clearly technical process, technical product, and management are the three leading issues, with resources and schedule following closely behind.

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Assessment Initiative Web Site—<http://tai.pica.army.mil>

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## About the Authors



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# Product Line Approach to Weapon Systems Acquisition

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*This paper focuses on the product line approach and its key features. We emphasize open systems and architectures and the development environment to support the approach. We discuss examples where this approach has produced outstanding results, and summarize findings that should encourage senior executives and program managers to embrace this approach.*

Ever since Ford established the first automobile production line, America has been sold on its value. The cornerstone of Ford's efficient manufacturing process has been confidence in each part to fit correctly, work properly, and perform reliably. Once a repeatedly identical process has been validated, product variations may be created that may meet differing consumer needs and tastes. The most usual variations are substitutions that provide a functional or visual change to comply with a pre-established interface. Companies that know their customers' needs will produce such product lines. Thus, the production line has been used virtually in every mass production industry.

Both commercial industry and the military have recognized the need for standards to assure quality and performance. For the past half-century, two independent standards bodies have been defining the quality and performance thresholds of products for the commercial and military sectors. But for the past 10 to 15 years we have been witnessing a convergence of these two marketplaces.

The military has been investing heavily in *force multiplier* technologies, including communication electronics, satellite-based navigation, new and advanced data processing, and sophisticated data fusion techniques that are being integrated into command and control weapon systems. What is fascinating is that the source of much of these technologies is the commercial sector. Commercial industry is producing increasingly more products with military application than ever. The Department of Defense (DoD) is rarely the market leader. And technology is advancing at unprecedented rates.

## Accepted Standards

Beneath the production line concept lie standards. These establish specific interface standards as opposed to process

standards that tell contractors how to build component form, fit, and function. Standards are accepted by industries that desire to participate in that market.

Companies producing commercial products usually comply with standards by professional associations such as the American National Standards Institute, International Organization for Standards, Underwriters Laboratory, Society of Automotive Engineers, and Institute for Electrical and Electronics Engineers.

In the past, companies that supplied military products had to comply with military standards. These two marketplaces evolved separately. It was not practical to adopt commercial quality for military products because of the severity of the military environments. Military standards were spawned to meet their peculiar needs.

Commercial standards allow us to develop systems that can be supported by a wide range of readily available products. They allow us to develop subsystems and components that are testable. They allow us to check for conformance. They give us economies that were previously unrealizable as well as higher levels of performance. Finally, they enable us to support legacy systems and internationalization.

Our involvement in establishing standards and specifications has been an important investment that we can leverage today. One way to leverage that investment is to implement acquisition solutions that are based on the best ideas and practices from our experience in this process. A product line approach to weapon systems acquisition is one idea that is gaining favor every day.

## Product Line Approach

A product line approach is a simple concept that is firmly grounded in industrial engineering and manufacturing. It encompasses the assembly line idea, where basic platforms or frameworks are

fitted with subsystems or components to form a larger system to deliver a specified capability. The subsystems and components are designed to specified levels of openness and feature modularity and interchangeable parts. Some subsystems or components may be common to a variety of weapon platforms and identically interface with each platform.

Linda Northrop, manager of the Product Line Systems Program at the Software Engineering Institute, defined a product line as, "a group of products sharing a common, managed set of features that satisfy specific needs of a selected market." [1] Product lines take advantage of commonality. Consumers would certainly enjoy the cost benefits associated with common parts. Designers, however, should not feel compelled to use common parts (more on this later).

Another quality of product lines is controlled product variability. Well-defined manufacturing processes usually employ quality ensuring techniques such as statistical process control to quickly identify process variances that define product quality and, thus, bound product variability.

A product line approach also incorporates an open system strategy, along the lines of the strategy defined by the DoD: "... An open system strategy focuses on fielding superior warfighting capability more quickly and affordably by using multiple suppliers and commercially supported practices, products, specifications, and standards [that are] selected based on performance, cost, industry acceptance, long term availability and supportability, and upgrade potential." [2]

This definition emphasizes the need to choose widely accepted standards for system interfaces and encourages system developers to leverage commercial technology wherever possible. An open systems approach incorporates this notion and

argues for engineering decisions driven by business considerations, modular design of hardware and software, and buying rather than developing system components.

Secretary of Defense Dr. William J. Perry was among the first to advocate an open systems approach, mandating greater use of performance and commercial specifications in 1994. In November of 1994, the Undersecretary of Defense (Acquisition and Technology) issued a directive to use open systems for the acquisition of weapon systems electronics. On March 15, 1996, DoD 5000.2-R expanded that directive to include open systems for all system elements. On March 23, 1998, the Defense Science Board's summer study of the Open Systems Joint Task Force (OS-JTF) concluded that an "open system process is an essential warfighting and Title 10 core value." There is a lot of policy emphasis on the idea of open systems, and the OS-JTF is specifically chartered to champion an open systems approach as the preferred technical approach and business strategy for acquiring all weapon systems.

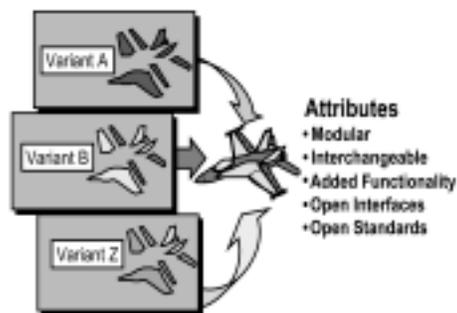


Figure 1. *Product Line*

Figure 1 illustrates the essence of the product line approach. The idea is to design and manufacture a system with subsystems and components to meet unique customer requirements. A single production line can accommodate the building of multiple configurations to meet those requirements.

An excellent example of the product line concept at work is manifested in the Joint Strike Fighter (JSF), where the U.K., U.S. Air Force, and U.S. Marines advocate variants for their unique needs, and the engineering impacts of those differences are integrated at the production line. The major attributes of this idea are modularity, interchangeability, added functionality, open interfaces, and open standards. The

basic platform for each variant is the same.

## Benefits Abound

A major plus is the opportunity to modernize a system with minimal integration and verification effort. Many technological advances occurring in the commercial sector will capitalize only by introducing products the consumer will buy. Provided these products comply with commercial interface standards, they should also comply with military systems that employ those same commercial standards, thereby negating the outlay for further research and development.

The scheme to implement new technologies may be done by a modernization through spares process in which new and improved components are procured and distributed for easy installation in the field. Testing could be limited to installation checkout. Operational availability would hardly be affected, and would more likely be enhanced. We need the ability to quickly integrate new technologies to improve performance, decrease risk, and reduce costs.

A case for product lines can be made by examining the Navy's AYK-14 standard airborne computer, and the Control Display Navigation Unit programs. These two programs have put naval aviation in an excellent position to pursue common hardware solutions due to their similar size, cooling and interface requirements. Cost of ownership is reduced due to shared development costs, increased procurement quantities (economies of scale), reduced support infrastructure, and common paths for modernization. But the case for commonality is not new.

The use of open systems architectures has given us the ability to meet the requirements of many users in a common approach with less effort than in the past. The Navy is poised to pursue common hardware solutions because of past efforts like AYK-14. Yet the Navy has the flexibility to use other implementations in their design solutions because they standardized on the interface, not the piece part.

A product line approach also facilitates the smooth transition to a plug-and-play/fight environment in the field at the platform system level. Figure 2 illustrates the plug-and-play/fight concept. The major elements of this idea are modular

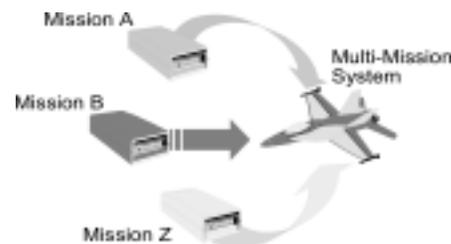


Figure 2. *Plug and Play*

design, operational tempo, deployment, cost of ownership, support, and training.

Modular design makes it easy to quickly change modules and parts on location at dramatically reduced costs. Simply remove a component that has failed, and replace it with a new one in the field. Modular design also provides greater mission flexibility and all it implies. A major benefit is that a modular design enables fielding fewer systems; and fewer systems mean reduced manpower, reduced logistics footprint, reduced deployment, and related issues. Fewer systems also mean lower costs of ownership and decreased support and training costs.

Operational tempo is also enhanced when there are fewer platforms in the operations area. For example, with fewer systems on the flight ramp, operators can rearm, refuel, and reconfigure for missions more efficiently and more effectively. Operators can also fly more sorties because of shorter turnaround times, increasing combat effectiveness.

Potential advantages for deployment are enormous. For example, we might be able to field one weapon system with the capacity to quickly reconfigure to service various other missions. If so, we can reduce the number of systems deployed to the theatre to achieve required operational capability. Conceivably, a single platform and several subsystems could replace many single- or limited-mission platforms.

An excellent example is the Army's Project Manager Signals Warfare. Between 1970 and 1980, combinations of six separate, unique systems comprised the Army's intelligence and electronic warfare capabilities. Six outdated programs—QUICKFIX (AN/ALQ-151), TACJAM (AN/MLQ-34), TRAFFICJAM (AN/TLQ-17A), TEAMPACK (AN/TRQ-103), TEAMMATE (AN/TRQ-32) and TRAILBLAZER (AN/TSQ-114)—were combined into a single program known as Intelligence and Electronic Warfare Common Sensor,

in which common modules could be deployed from four different platforms.

Each module featured interfaces common to the four platforms that could easily plug and deploy to execute their respective missions. Life cycle cost savings were estimated at nearly \$845 million. [3]<sup>1</sup>

Another twist on this notion is the idea of product affinity, where a single component is used in a range of platforms. If each platform has identical component interfaces, it can be used across a range of systems. Figure 3 illustrates this idea. The benefits of product affinity include economy of scale, logistics, training, paying for recurring engineering only once, and modernization through spares.

### Benefits Continue Over Time

A plug-and-play/fight concept brings obvious advantages such as reduced cost of ownership, improved supply support, and less complicated maintenance training. While research and development costs are likely greater due to investing more resources in the product line, large savings in operations and support costs should be realized over time.

Another benefit of the product line approach is reuse. The idea is to reuse modules again and again. Figure 4 illustrates the idea behind Bold Stroke, an initiative in the Boeing Corporation to extend advantages of the Open Systems Core Avionics Replacement (OSCAR) program to a fleet of aircraft—the F/A-18E/F, the F/A-18C/D, and the F-15E. The OSCAR program objective is to modernize the AV-8B (Harrier) aircraft to make it more operationally viable through the year 2023.

The Harrier is being modernized because of delays to the JSF. The Harrier was not expected to remain in force inventory because the JSF would eventually serve in its stead. But as JSF program delays mounted, force planners acknowl-

Figure 3. Product Affinity

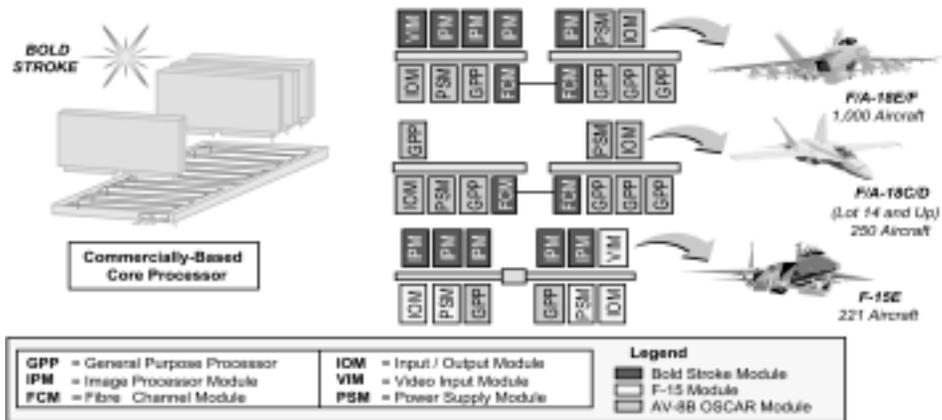
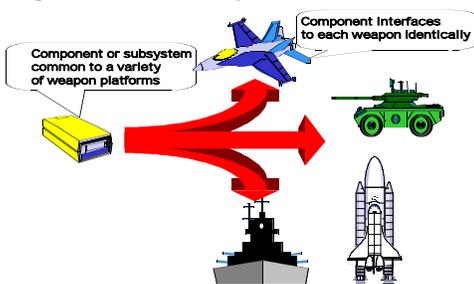


Figure 4. Reuse: A Key Open Systems Benefit

edged that the Harrier would not only have to be supported through the duration, but also modernized.

New tactical weapons, such as Joint Direct Attack Munition and Advance Medium Range Air-to-Air Missile are entering the inventory. Satellite-based navigation equipment is replacing land-based stations. Newer, more secure communication is beginning to replace older analog radios. To accommodate new weaponry and avionics, many core changes to the Harrier were required affecting equipment right down to the backplane.

The circumstances leading to the Harrier's modernization could be reasonably anticipated for other aircraft. Management at Boeing, a major producer of tactical aircraft, initiated a program called Bold Stroke embracing product-line approaches and open systems principles. The idea was to extend OSCAR experiences into their family of aircraft. Boeing wanted to provide *hooks* for affordable modernization.

Referring to figure 4, many of the modules developed for OSCAR (stores management and mission computer processors and input/output devices) were directly applicable to the F/A-18 C/D and E/F models and the F-15E. Without further nonrecurring engineering investment these modules were integrated into each of the other tactical aircraft. At Boeing's own expense, they developed modules (image processors, fiber channel modules, and video modules) that were compatible with the avionics systems for each aircraft.

Bold Stroke uses commercial-based components and standard interfaces common across platforms, and accommodates plug-and-play components.

### Product Line Application

So how do you apply a product line approach? Start in the requirements phase of a weapon system acquisition, when there are adequate opportunities to determine if commercial components can satisfy needs. Figure 5 suggests four considerations. After you know basic requirements, conduct market research to identify technologies that are going to have staying power and/or the capacity to be modularized in the design. Second, look at the technology trends. What is the future? What are the product line attributes? Will obsolescence be an issue? Where is the baseline? What are the risks? Are there vendor monopolies? What is the competition? How can we leverage it?

Market research should result in information to assist program managers and their acquisition teams in making informed decisions on the systems architecture. Projections on evolving technologies and how those technologies affect subsystem availability, reliability, maintainability, and cost should all be factored into acquisition and support strategies. These projections are not only relevant to system components, but also to interfaces and the commercial standards that may be used to define system interfaces. Design managers must be equally concerned with matters affecting the longevity of interface standards, which evolve with technology trends like products.

Figure 5. Managing Technologies



Finally, think about system planning. When is the system going to production? How does the schedule correlate with the technology trends? Do not baseline on an old technology; baseline on a product line.

## Moving to a Modular Open Architecture

An open systems architecture is the key to leveraging the marketplace for affordable modernization. Openness is created by selecting interfaces based on nonproprietary, consensus-based standards. A systems architecture provides a high-level view of the weapon system and gives an idea of appropriate interface use and standards. This view helps acquisition officials identify opportunities for commonality, horizontal technology integration, new technology insertion, and multiple sources of supply. By taking advantage of these opportunities, program evaluation officers (PEOs) and program managers can field superior weapon systems faster and at a lower cost of ownership.

The degree to which PEOs and program managers can realize the benefits of an open systems approach depends on how widely the standards are supported in the marketplace, and how widely they are used in the systems community. That is, if similar standards are applied across a large number of weapon platforms or across several different weapon system domains, like avionics or ground vehicles, more benefits (e.g., increased commonality and reuse) will likely be achieved than if standards are applied to a particular weapon system.

The application of the open systems approach to legacy systems is beneficial as well. But the benefits are less obvious. Legacy systems usually have size, space, power, cooling, and shape factor constraints. For these systems, the open system solution can provide form-fit-function interface (F3I) solutions within the existing packaging, power, and environmental constraints. In such cases, the open systems solution frequently requires less system resources by using newer, more efficient technologies. The open system approach is similar to F3I except that the open systems approach emphasizes choosing interfaces that are broadly accepted in the marketplace to allow for as many suppliers as possible over the long term.

### Architecture Types

Acquisition managers have to deal with three types of architectures (see figure 6). The first is the operational architecture or the environment in which the system must operate. It defines the rules for interoperability. It is a systems engineering process input. Next is the system architecture, which is the physical arrangement of subsystems and components that defines the system. Third is the technical architecture or the rules associated to the domain of the systems

The operational architecture specifies user requirements that are inputs to the systems engineering process used to build the system. This architecture describes the “operational elements, assigned tasks, and information flows required to support the warfighter. It defines the type of information, the frequency and timeliness of the exchange, and what tasks are supported by these information exchanges [4].”

The technical architecture sets forth rules that constrain the design of the system during the systems engineering process. These rules govern the arrangement, interaction, and interde-

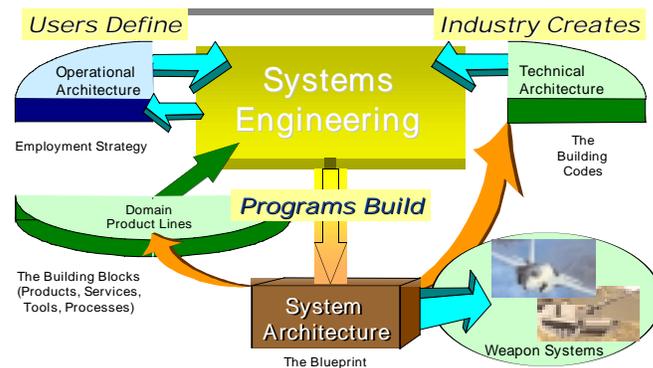


Figure 6. *Architecture Types*

pendence of the parts that make up a conformant system, one that satisfies a set of requirements. It defines services, interfaces, standards and relationships. The technical architecture is the framework for engineering specifications and is based on operational architecture requirements.

### Commonality Issues

Does the product line approach cause or force commonality? It may cause it, but it certainly does not force it. Acquisition teams may either accept or reject commonality in their product lines, but are not consigned to the notion of commonality.

The concept of open systems promotes design flexibility to permit alternative implementations and opportunities for affordable modernization. Commonality by its very nature limits design options causing sub-optimization, or in other words, performance inefficiencies, maintenance limitations, and cost burdens.

### Conclusions

Experience to date shows outstanding results for adopting a product line approach to acquisition. Findings include:

#### Improved Return on Investment

A product line approach, which applies basic principles of the open systems approach, promises huge returns on investment. We cited the Army's Intelligence and Electronic Warfare Countermeasures Suite (IEWCS) program in which cost avoidance was projected at about \$845 million. The IEWCS program was restructured for reasons not related to the acquisition strategy, but the results validated open systems and the product line approach. This program clearly illustrated the potential of an open systems development to provide opportunities for affordable technology insertion across application domains and services.

#### Decreased Deployment Burden

We have already discussed some advantages for deployment. The sheer volume of equipment required to support military operations in remote areas is staggering. Initial supplies delivered by airlift typically require 72 hours. The bulk of the remaining equipment and support arrive via surface transportation, which typically requires 14 days. Transportation command officials estimated the Desert Storm deployment was equivalent to moving the city of Memphis, Tenn. Product line concepts in which single-mission equipment is replaced by multimission equipment would certainly have a profound effect on mobility and force projection.

#### Improved Operational Tempo

Implications of product line approach to operational tempos are mission sortie turnaround times. **[Continued on page 23.]**

# Evaluating Risk in Competitive Procurements

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*There is more to many competitive federal procurements than just automated systems; they involve the full range of services that constitute a government function, such as wholesale logistics. The winning vendor must perform a large part of the chosen function in addition to providing the actual systems. Since services are much less tangible, the government needs a reliable measure of process risk to determine the winning bidder. The Process Risk Evaluation (PRE) recently used by the Army is a flexible tool (based on the Capability Maturity Models®) that measures risk and helps agencies evaluate competing bids. This article discusses the development and application of the PRE and its utility for competitive procurements of major systems and service solutions.*

As the name implies, the PRE is a new method for evaluating process risk, specifically in programs that require integration of multiple commercial off-the-shelf (COTS) packages or new systems.<sup>1</sup>

## The Procurement

In April 1999, the U.S. Army Communications-Electronics Command (CECOM) issued a request for proposals (RFP) for the Army Wholesale Logistics Modernization Program (WLMP). The Army wanted to modernize the way it provides wholesale logistics services. The goal was not simply to enhance current processes, but to reengineer them by using commercial best practices and new technology.

The RFP required the chosen vendor to perform three major functions:

- Reengineer current wholesale logistics business processes.
- Sustain existing systems while in transition to new ones that support the reengineered processes.
- Manage the interfaces with external systems such as personnel or finance, which must communicate with existing and new systems.

The WLMP procurement—a 10-year contract—was significant in cost as well as scope. It did not procure a new *system*, but the full range of *services* that constitute the wholesale logistics function. The winning vendor would perform most aspects of the wholesale logistics function. Since services are much less tangible than a system, the Army's need for a reliable measure of process risk—how a service will be provided—was paramount.

## Need for an Evaluation Method

As the RFP was being written, a dilemma arose. The evaluation team, three Army personnel and three contractors, recognized that the standard evaluation method—the Software Process Risk Evaluation (SPRE)—was inappropriate for measuring the process risk for this procurement.<sup>2</sup> It did not include all process risk areas covered in the RFP.

The SPRE was effective in evaluating many types of software development efforts but was not designed to evaluate areas outside of the traditional realm. The team could use the SPRE to evaluate some WLMP processes, including customization of COTS software and development of new software (for managing interfaces and other limited development). But it needed a new way to address other areas, including business process reengineering, sustainment of existing systems, and transition to new systems.

Consequently, the Army needed to augment the SPRE processes to achieve a more complex, robust risk evaluation

method in the RFP. The evaluation team, using process areas selected from both the Capability Maturity Model for Software (SW-CMM) and the Systems Engineering Capability Maturity Model (SE-CMM), arrived at an alternative to the SPRE for measuring process risk—the PRE.

The WLMP procurement required a vendor to provide a range of logistics services including:

- Logistics modernization:
  - Business process reengineering and analysis.
  - Planning, to describe how the vendor's services will meet requirements and how new systems will be implemented.
  - Process trials to validate description and implementation plans.
  - Implementation of the wholesale logistics services.
- Sustainment:
  - Recurring services, including round-the-clock user support, controlled access to systems and data, corrective and adaptive maintenance, subject matter expertise for functional areas supported by the systems, integrity of software baselines, and requirements analysis services.
  - Additional functionality, in-process changes, and continuous process improvement.
- Transfer of the expertise, workload, software, and documentation associated with sustaining the functionality of the wholesale logistics legacy systems.
- Data processing services for transferred systems and modernized systems.
- Related logistics services to support other relevant logistics programs, including systems with which the WLMP must interface.

## The Process Risk Evaluation

The following major phases of the WLMP procurement, which apply to other procurements of this type, provide the framework for discussing the PRE:

- RFP development.
- Vendor questions on the draft RFP.
- Evaluation of vendor proposals.
- Site visits to evaluate vendor processes.
- Source selection.

## RFP Development

In developing the PRE, the team's objective was to incorporate in the RFP a method of evaluating the performance risk associated with each vendor's proposal. Since the Army would not be managing the day-to-day operations of the winning vendor, the RFP needed to provide a comprehensive method for identifying process risk beforehand.

To accomplish this objective, the team began by including all process areas from the SPRE in the PRE. Then it analyzed an early version of the Capability Maturity Model-Integrated<sup>SM</sup> (CMM-I) for additional process areas and associated goals relevant to the RFP. In all, the team developed a list of 21 process areas on which vendors would be evaluated. Since the CMM-I itself is a hybrid of other models, each process area could be traced back to its original source in either the SPRE (based on the SW-CMM) or systems engineering CMM (SE-CMM).

Table 1 lists the 21 process areas and their sources.

Under the PRE, vendors are judged not by the maturity level they have achieved (as is customary in software related procurements), but by the overall risk rating achieved in the process areas. The evaluation team assigns a risk rating of low, medium, or high. No mention of maturity levels is included in the RFP.

For each process area the team develops a description, goals, and set of questions that it would ask to evaluate a vendor's capability. Developing the goals and questions is an important effort because fleshing out the topics in each area provides the basis for evaluating each vendor's ability. If the goals or questions are incomplete, important functions or services might not be accurately evaluated. The team derives the goals in each process area from the relevant maturity model.<sup>3</sup>

Because of the nature of this type of procurement—for services, not just for a new system—and the limited amount of process control that the government can exercise over the vendor, the risk evaluation method is all the more important in protecting the government's interests and ensuring that the vendor can perform as expected. The sponsoring agency needs confidence in the risk evaluation method.

### Vendor Questions

After completing and publishing the draft WLMP RFP, the team made it available on an Army Web site. Interested vendors responded with comments and questions. Judging from their responses, the concerns were more procedural than content oriented. For example, they requested clarification on the requirement for documentation on past projects.

Table 1. PRE Process Areas and Sources

Process no.	Process area name	Source
1	Analyze candidate systems	SE-CMM
2	Configuration management	SW-CMM
3	Coordinate with suppliers	SE-CMM
4	Evolve systems architecture	SE-CMM
5	Integrate disciplines	SE-CMM
6	Integrated project management	SW-CMM
7	Integrate system	SE-CMM
8	Manage product line evolution	SE-CMM
9	Manage risk	SE-CMM
10	Organization process definition	SW-CMM
11	Organization process focus	SW-CMM
12	Peer reviews	SW-CMM
13	Process change management	SW-CMM
14	Project planning	SW-CMM
15	Project tracking and oversight	SW-CMM
16	Quality assurance	SW-CMM
17	Requirements management	SW-CMM
18	Software product engineering	SW-CMM
19	Technology change management	SW-CMM
20	Training program	SW-CMM
21	Understand customer needs and expectations	SE-CMM

The participating vendors were accustomed to a requirement for CMM certification at a specified maturity level, but not to the PRE—a method including process areas on which the vendors had not been previously rated. In spite of this vendors had minimal uneasiness with the PRE as an evaluation method, and they believed that no important process areas had been omitted. On the basis of vendor comments the team made minor editorial changes to a few process areas, but did not add to or delete from the original list (Table 1). It then issued the final RFP.

### Evaluation of Vendor Proposals

In their proposals vendors should describe how they will perform the PRE processes and submit documentation to show their ability to do so. In the case of the WLMP, the vendors discussed the 21 PRE processes listed in Table 1 and submitted documentation on six previous projects to demonstrate their ability to perform those processes.<sup>4</sup>

All evaluation team members review the risk section of all vendor proposals.

### Site Visits

The evaluation team visits the vendors whose proposals pass the written evaluation (for WLMP, two prime contractors and one major subcontractor). During the visits vendors provide all relevant documentation for previous projects and make project and management personnel available for interviews. The evaluation team selects the projects that provide the most insight into the vendor's process maturity. The vendor's project documentation should be available for the entire site visit.

On the first day of a site visit the vendors describe the processes they used. Next, the team and vendors discuss the selected projects. These discussions also center on the vendor's processes for accomplishing the PRE areas. Vendors are required to ensure the availability of specified personnel, from senior management to team leaders, who are familiar with either the project's management or with specific processes in use. (For WLMP, the team also interviews members of the vendor's Software Engineering Process Group.)

All evaluation team members review vendor documentation before the interview to determine which areas need additional clarification. The interviews are also an opportunity to ask questions that arise during the proposal review. All evaluation team members also attend each vendor interview. However, two team members (one primary and one secondary) oversee each area and ensure that the evaluation is thorough and accurate.

The documentation for review should be cross-indexed by process area for easy access by the evaluation team. When vendors who passed the written evaluation have all achieved at least CMM Level 3, the documentation they provide directly relates to the evaluation team's requirements.<sup>5</sup> In competitions involving vendors of lower maturity, the team's job could be more burdensome because the documentation might not clearly indicate a vendor's use of CMM processes. The lower the vendor's maturity, the more likely the evaluation team is to uncover shortcomings.

On the basis of the interviews and project document review, each team member rates the vendors in the process areas and develops a list of vendor strengths and weaknesses. Then the team discusses its findings and agrees on a single rating for

each area. A vendor is assigned one of three risk ratings: low, medium, or high. Low risk, for example, indicates that "little doubt exists, based on the vendor's performance record, that the vendor can perform the proposed effort." In addition to assigning a rating for each process, the team consolidates and summarizes the list of strengths and weaknesses.

The team bases the vendor ratings on the information gathered in three venues: evaluation of proposals, interviews and review of project documentation during site visits, and vendors' written responses to final questions raised by the team. Because the information gathered during the site visits validates the information provided in the proposals, it is at least as important as that provided in the proposals.<sup>6</sup>

### Source Selection

After deciding each vendor's rating the team prepares its results for submission to the source selection evaluation board (SSEB). The SSEB prepares and presents a report for the source selection authority (SSA), which makes the final procurement decision. The evaluation team provides the SSEB with the overall risk rating for each vendor, as well as a summary of the vendors' strengths and weaknesses. The SSA used this information to make its WLMP award decision, which was announced in Dec. 1999.

### Lessons Learned

On the basis of the WLMP procurement, the team reached the following conclusions concerning the PRE:

(1) The PRE was effective in covering all key process areas of a very complex program. Because CECOM normally conducts its procurement according to a sanctioned methodology (SPRE) and a single process model (SW-CMM), there were initial concerns about adopting an alternative unsanctioned method. However, after using PRE to determine process risk, the team was confident that it had identified all key processes and collected sufficient information from the vendors to provide accurate input to the SSEB.

(2) Much of PRE's effectiveness is due to its basis on processes of the CMMI and predecessor models. The PRE was built on a firm foundation and offers many of the same benefits as CMM, including the increased likelihood of success for projects using it. The PRE is also a means of using CMM processes when a procurement does not fit neatly within a single maturity model.

(3) The PRE method is resource intense. To be useful, it must be scaled to the size of a specific procurement. For procurements smaller than WLMP, the number of process areas evaluated can be decreased. One team member was recently involved in a procurement for system maintenance services. For that procurement only six of the 21 process areas were necessary for determining process risk. Alternatively, the size of the evaluation team could be scaled down. The WLMP team consisted of six members; smaller teams are appropriate for simpler procurements.<sup>7</sup>

(4) The PRE works best when evaluation team members understand the CMM models and the PRE process. The WLMP site visits were accomplished in one week because the team knew the types of information to collect from vendors. This understanding allowed team members to ask the right questions in interviews and to recognize relevant documentation

in the ocean of paper that each vendor provided. Knowledge of CMM also helped the team compare vendor statements about their processes with what the vendor documented on past projects. Without this knowledge, the site visits and evaluation period would have been significantly longer, and valuable information might have been overlooked.

(5) Similarly, the PRE consumes more resources in procurements involving vendors of low CMM maturity. Vendors in the WLMP competition were well grounded in CMM methods and provided documentation that demonstrated the use of CMM-compliant methods in conducting projects. Without this experience the evaluation period would have been longer and more expensive.

(6) After a few initial misgivings, the PRE gave rise to little organizational resistance. As it is based on CMM processes, it is no more burdensome than a classic Software Capability Evaluation; since the PRE can be modified to fit a given procurement, it applies to many organizations. The WLMP program manager considered the PRE a useful means of collecting the information necessary for selecting the best vendor. He was very receptive to the PRE, and said that it evaluated many areas that would matter to him during implementation. As the customer of this procurement, his satisfaction with the method was critical to its adoption.

### Additional Information

For more information, please contact Jeffrey Herman at 732-532-8071, or Timothy Carrico at 703-917-7486. Herman, U.S. Army Communications-Electronics Command (CECOM), Software Engineering Center, led the WLMP evaluation team. Carrico, a program manager at the Logistics Management Institute, was the primary architect of the PRE method. ♦

### Notes

1. "Integration" can be internally focused (e.g., running modules of a legacy system while modernizing it) or externally focused (e.g., developing interfaces with external systems while the legacy system is being modernized). The WLMP procurement required both types.
2. The SPRE is the Army's implementation of the Software Capability Evaluation 3.0 method. It evaluates the performance of the key process areas (similar to the processes listed in Table 1) of the SW-CMM and is the Army's basis for rating vendors bidding on procurements involving software development.
3. In the case of the WLMP, the team derived the questions for process areas in the SW-CMM from the SPRE; for processes not covered by the SW-CMM, as well as for business process reengineering topics, the team developed its own questions.
4. For vendors bidding as teams, at least one principal had to have worked on each past project in order to bid for the WLMP.
5. For the WLMP, the documentation provided by each vendor filled 50 to 100 boxes per project.
6. The Army considers site visits so important that its SPRE method relies much more heavily on information gathered from site visits than on evaluation of vendor proposals. The Army prefers to judge a vendor by the processes in use rather than by the proposed execution of future projects.
7. The six team members made three week-long site visits, spent one to two weeks evaluating vendor proposals, and spent a few days on miscellaneous tasks such as following up with vendors on final questions and preparing consolidated ratings.

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## Coming Events

**November 10**

*Information Outlook 2000 (Australian Computer Society)*  
[www.acs.org.au/act/events/io2000/index.html](http://www.acs.org.au/act/events/io2000/index.html)

**November 16-17**

*ACM Conference on Universal Usability*  
[www.acm.org/sigchi/cuu](http://www.acm.org/sigchi/cuu)



**December 4-7**

*International Conference on Power System Technology*  
[www.ee.uwa.edu.au/~aips/powercon](http://www.ee.uwa.edu.au/~aips/powercon)

**December 11-13**



*Global Development Network Conference*  
[www.gdnet.org](http://www.gdnet.org)

**January 18-19**

*2001 Measurement Science Conference*  
[www.msc-conf.com/findex.html#cfp2001.html](http://www.msc-conf.com/findex.html#cfp2001.html)

**January 25-27**

*Ryerson 2001: A Software Approach*  
[www.ryerson.ca/~csie/2001](http://www.ryerson.ca/~csie/2001)



**January 30-February 2**

*CIEC 2001 Odyssey: Industry & Education Engineering*  
[www.asee.org/conferences/html/ciec2001.htm](http://www.asee.org/conferences/html/ciec2001.htm)

**February 7-9**

*Network and Distributed System Security Symposium*  
[www.isoc.org/ndss01/call-for-papers.html](http://www.isoc.org/ndss01/call-for-papers.html)



**March 5-8**

*Mensch and Computer 2001*  
<http://mc2001.informatik.uni-hamburg.de>

**March 31-April 5**

*Conference on Human Factors in Computing Systems*  
[www.acm.org/sigs/sigchi/chi2001](http://www.acm.org/sigs/sigchi/chi2001)

**April 29-May 3**

*Software Technology Conference (STC 2001)*  
[www.stc-online.org](http://www.stc-online.org)



**May 1-3**



*IEEE Radar Conference*  
[www.atlaessgrss.org/radarcon2001](http://www.atlaessgrss.org/radarcon2001)

**May 6-9**

*IEEE International Symposium on Circuits and Systems*  
[www.elec.mq.edu.au/iscas01](http://www.elec.mq.edu.au/iscas01)

**May 12-19**

*23rd International Conference on Software Engineering/International Workshop on Program Comprehension*  
[www.csr.uvic.ca/icse2001](http://www.csr.uvic.ca/icse2001)



# Writing an Effective IV&V Plan

Dan F. Walters  
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*The uniqueness and complexity of sophisticated software development requires a well planned and executed program, especially in the area of Independent Verification and Validation (IV&V). The introduction of the Capability Maturity Model® (CMM) and other documentation production schema has changed the way software production is managed and certified.*

This article provides a methodology for writing an IV&V plan based on the Institute of Electrical and Electronics Engineers (IEEE) standards and updated as a result of three U.S. Navy project iterations. The plan's ideas and format are the result of these iterations, and they incorporate CMM concepts and reduced document maintenance costs. The comprehensive plan covers the full spectrum of IV&V project involvement but can easily be tailored to any level of IV&V effort.

In the current software development environment with automated tools, reduced budgets, and CMM, the task of writing an effective IV&V plan requires a well planned and open-minded approach. The current guidance and documentation for the preparation of IV&V plans, such as [1] and [2], are vague and should incorporate current topics such as CMM.

Today, companies bidding on software development contracts use terms such as CMM Level 3, 4 and 5 in their proposals. Sometimes several organizations within the corporate structure have not achieved a Level 3 or higher, but the company bids the corporate or division CMM level. Since a company bids itself as a CMM Level 3 or higher, the group letting the contract may assume all organizations bid within the company are at the proposal's level and thus no IV&V effort is needed. In some cases this assumption is true but many projects have fallen into this pitfall.

Instances where the assumption is false create a situation where the "children are watching themselves," and there is a need for an IV&V effort to watchdog the software developer. Sometimes organizations are downsized to a level where they cannot oversee the software development and may require IV&V support. The decision whether to have IV&V support should be made at or as close to project start-up as possible. Generally the IV&V support is begun at the requirements definition phase.

When the decision is to perform

IV&V, a plan is required. The IV&V organization may not have attained a CMM Level 2 or higher rating. Level 2 is defined as "repeatable," which indicates there are some processes that are followed for each effort. Level 3 is defined as "defined," indicating the team has standard processes to follow and a documentation library. The IV&V effort may be tasked to monitor the software developer's compliance with their standard software development processes.

This article provides tips, ideas, and a framework developed while producing master IV&V plans on three U.S. Navy projects. The basic structure provided by the IEEE standards [1] and [4] for verification and validation plans was modified and updated to produce the framework for this IV&V plan.

Many IV&V plans omit an important statement: "This plan is a living document." IV&V plans are dynamic and must be updated as the software project matures. Thus any IV&V plan must be flexible and provide means for implementing changes.

Another myth many have fallen into is that IV&V is synonymous with testing. Although testing is a very important activity within IV&V, it is not necessarily restricted to this activity. IV&V methodology is also important to requirements and design phases of the software development life cycle and software maintenance.

First several definitions from IEEE [3] are needed:

*IV&V* is defined as "performed by an organization that is technically, managerially, and financially independent of the development organization." The organization is usually external to the software development company.

*Verification and validation* is defined as "the process of determining whether the requirements for a system or component are complete and correct, the products of each development phase fulfill the requirements or conditions imposed by

the previous phase, and the final system or component complies with specified requirements."

*Verification* is defined as "the process of evaluating a system or component to determine whether the products of a given development phase satisfy the conditions imposed at the start of that phase, providing formal proof of program correctness."

*Validation* is defined as "the process of evaluating a system or component during or at the end of the development process to determine whether it satisfies specified requirements."

With these definitions in mind, we will now approach the structure of the IV&V plan. An assumption is made that plan development will be performed on a PC in a Windows environment. All files associated with the document and appendices are stored in the same Windows folder or contain internet/intranet access to all external documentation.

## IV&V Plan Structure

### Section 1: Introduction

This section contains four general topics. Topics 1 and 4 are the same as Section 1 in IEEE standards [1] and [4]. Topics 2 and 3 have been added to ensure everyone understands the objectives, goals, and approach. Topics 2 and 3 must be completed before any subsequent parts of the plan can be written. These two topics drive the development of the plan.

1. **Purpose**—This topic answers the question, "Why is this plan being written?" In some documents it is referred to as Scope.
2. **IV&V Objectives and Goals**—This topic lists the main objectives and goals for the IV&V effort. These form the basis for performing the IV&V.
3. **IV&V Approach**—This topic describes the high-level methodology and how it fits in with the development cycle. This material is dependent on the CMM level of both the software developer and the IV&V agent. This approach is further decomposed in Section 4.

**4. System or Project Background**—This topic provides a general understanding of the project under study.

### Section 2: Referenced Documents

This section is the same as Section 2 in IEEE standards [1] and [4]. Within this section are references to all associated documents, processes, and plans that provide information to complement this plan. Whenever possible, hyperlinks to the document locations should be included. If the documents are stored in a CMM Level 3 program library this is a simple effort. Using hyperlinks, documentation revisions and dates will not need to be maintained in the plan. Maintenance cost savings will be realized since the information is not maintained as part of the IV&V plan, thus changes in the external documentation remain at the external documentation level, i.e. program library.

### Section 3: IV&V Overview

This section discusses the project organization, schedules, resource allocation and tools, techniques, and methodologies. Generally, this section follows Section 4 in IEEE standards [1] and [4], except for the Work Breakdown Structure (WBS) addition to Topic 1 and the use of the appendices.

**1. Organization**—This topic describes the project organization providing the roles and responsibilities of all participants. A WBS or similar organizational breakdown is included. We recommend placing the WBS in an appendix as described later. In addition, this topic describes the use of integrated product teams or other means to coordinate the workload.

**2. Schedule**—This topic discusses the project management plan and the IV&V master schedule, which must be strongly coupled to the project plan. Since all schedules are constantly changing, we recommend placing the actual schedules in an appendix as described later.

**3. Resources Summary**—This topic summarizes the resources required to perform the IV&V tasks, including the personnel comprising the IV&V team and their technical experience requirements, test support equipment descriptions, and test site facilities. It is recommended that the specific personnel resources allocations be placed in the appendices as described later to allow changes to be made independent of the IV&V plan.

**4. Tools, Techniques and Methodologies**—This topic discusses access to data and facilities and the automated tools, techniques, and methodologies that will be required to perform the IV&V tasks.

### Section 4: IV&V Activities, Tasks, and Products

Section 5 in IEEE standards [1] and [4] describes the IV&V effort in a chronological order. The government is moving toward the Earned Value Management System (EVMS) on new Department of Defense projects and contracts as its method of tracking contract progress and cost. To prepare for this, we have found a WBS-like organizational approach to be the easiest to implement. EVMS practically demands this approach. For this reason, this section describes the five integrated IV&V activities that perform the IV&V tasks: management, requirements analysis, design analysis, independent testing and analysis, and process improvement. Figure 1 shows how these activities are integrated.

Each activity contains paragraphs for inputs, descriptions of the activity's specific tasks, metrics, outputs, and resources needed. Metrics are included for each activity and are reported to the IV&V management activity, which evaluates the metrics and generates progress and cost reports to the project manager. Some examples of the IV&V metrics can be found in Annex E of reference [4].

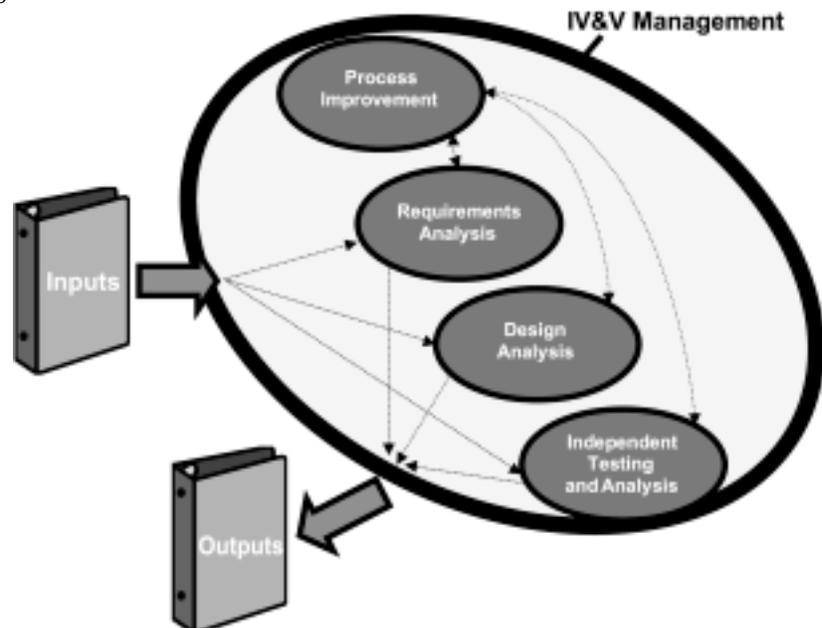
**1. IV&V Management**—This activity is the focal point for all inputs and outputs to and from the IV&V team. Issues iden-

tified in the course of analysis activities are reported out via this activity. All documentation and project data are received by this activity and flow to the appropriate analysis activity for processing. IV&V management can be broken down into planning tasks that include generation and maintenance of this plan, directing tasks, reporting tasks, and controlling tasks.

**2. Requirements Analysis**—This activity verifies that system, software performance, and interface requirements have been prepared in accordance to a standard set of criteria. If the software developer is a CMM Level 3 or higher, this activity also verifies that requirements are prepared in accordance to the standardized processes. The criteria set should be defined in this plan unless a lower level requirements analysis plan will be written. There are three main task areas in this activity: documentation analysis, interface requirements analysis, and requirements traceability analysis. System and software performance requirements are analyzed in the first area.

**3. Design Analysis**—This activity verifies that the software design and implementation phases of the software life cycle are performed in accordance with the software development plan. The task areas comprising this activity include design analysis planning, design products analysis, interface design analysis, code analysis, and design traceability analysis. The interface design analysis may be combined with the interface requirements analysis if a single interface design specification is provided as an input to IV&V. The design traceability focuses on the trace-

Figure 1 IV&V Activities



ability of the performance and interface requirements derived during the requirements analysis activity to the design documentation and code implementation.

**4. Independent Testing and Analysis**—

This activity reviews the test artifacts, develops the IV&V test plan, evaluates the testing process, and integrates the independent testing tasks. The basic task areas are independent testing and analysis planning, which includes the test plan generation; independent testing and analysis, which includes general descriptions of the types of IV&V tests to be performed as described in the IEEE standards; and independent testing and analysis reporting, which describes the processes to report testing results. This activity also coordinates with the project test and evaluation (T&E) team to reduce test redundancy and performs the validation tests assigned by the T&E manager.

**5. IV&V Process Improvement**—This activity is not included in the IEEE standards and supports CMM Level 3. It receives recommendations from the other activities for new analysis processes or changes to the current IV&V methodologies. Included are descriptions of how new tools, ideas, and concepts will be evaluated for incorporation into the IV&V processes. Key task areas are concept assessment, tool qualification, and reporting.

**Section 5: IV&V Products**

This section is similar to Sections 6 and 8 of the IEEE standards [1] and [4] and describes the various reports and artifacts produced during the IV&V effort. Outputs from the activities described in Section 4 should be categorized as either required or optional reports. Figure 2 shows the flow-down of the products.

**Section 6: IV&V Administrative Procedures**

This section tracks closely with Section 7 of the IEEE standards [1] and [4]. It discusses the general administrative topics such as anomaly reporting and resolution, task iteration policy, process deviation policy, and control procedures. The first two topics cover procedures for reporting issues, defects, etc. found during the analysis activities, along with tracking the issues through either fix implementation or deferred or cancel status. Process deviation policy describes the procedure to be followed to deviate from the IV&V master plan. One statement that must be

in the process deviation policy is, “Any such deviations will be documented and approved before they are allowed to occur.” The control procedures include the IV&V products and data configuration management, quality assurance, protection and security, and storage procedures.

**Appendices**

Since the IV&V plan is dynamic, those references that will undergo continuous modification and result in potential risk areas should be placed in the appendices using hyperlinks to the actual referenced data, preferably located in the same Windows folder.

Examples of these references are the project master schedule, IV&V schedule, and work breakdown structure and personnel resource allocations.

This concept is new to the IEEE standards and is used for risk mitigation during development and maintenance of the IV&V plan, reducing maintenance costs.

Risk events that can cause major changes to the IV&V plan are development schedule slippages, test equipment and simulation software development delays, and test and delivery site equipment deliveries and/or checkout delays.

Another major risk mitigated by this concept is the loss of key personnel. By hyperlinking to the associated data, the IV&V plan remains current without additional maintenance when a project change occurs, and without the need to modify the IV&V plan each time a change occurs.

Appendix A contains the glossary with all acronyms and major terms defined. The IEEE standards include this

as Section 3 but since this list is always changing, a better location is Appendix A. This way a list of the project’s acronyms and major terms may be updated and a new Appendix A distributed without a new release of the document.

**Summary**

While IEEE Std 1012-1998 provides a considerable amount of detail about what is involved in verification and validation, this article presents tips and ideas implemented with success during the development of three unique U. S. Navy IV&V efforts: TOMAHAWK, National Missile Defense, and Cooperative Engagement Capability (CEC). Each iteration provided new ideas culminating in the plan’s structure described above.

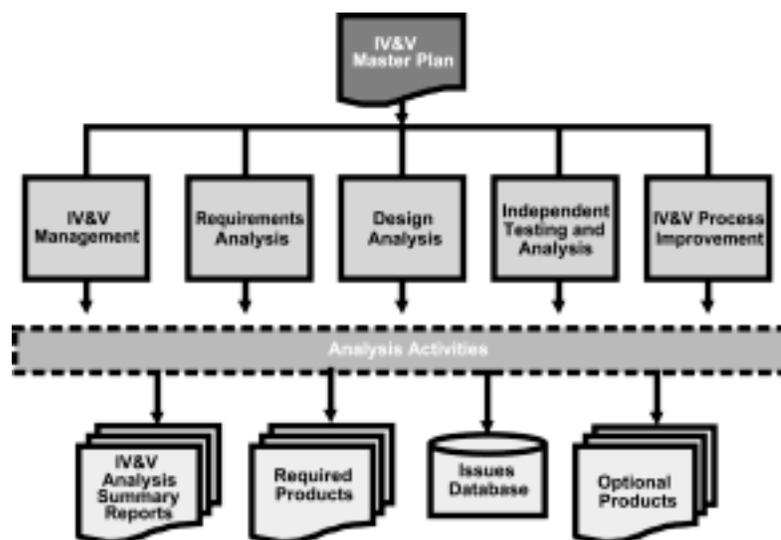
The IV&V Plan for CEC added the IV&V process improvement activity and the concept of hyperlinked Section 2 and appendices. CEC schedules change several times each quarter, sometimes weekly. By hyperlinking to a project schedule file within the same folder, only the project schedule file is updated, and a new revision of the document is not required.

This plan encompasses a full spectrum of involvement in a software development life cycle from requirements definition through maintenance. Any IV&V project team can easily tailor this plan to meet their specific objectives and goals. If the IV&V effort begins at the acquisition phase, this plan can be adapted easily.

There are four very important lessons to be learned from this article:

1. If EVMS or a similar cost tool is

Figure 2. IV&V Products Flow



- required, follow a WBS-like approach.
- An IV&V process improvement activity is needed to address the CMM level requirements. This activity is at the same level of importance as the other IV&V activities.
  - All items that will change continuously over the life cycle, should be placed in appendices that are hyperlinked to the project master files if possible, or copies in the same Windows folder as the IV&V plan.
  - Hyperlink all document references in Section 2 to project master files if possible to reduce redundant maintenance efforts. ♦

## References

- IEEE Std 1012-1986, *IEEE Standard for Software Verification and Validation Plans*.
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- IEEE Std 610.12-1990, *IEEE Standard Glossary of Software Engineering Terminology*.
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## Product Line Approach to Weapon Systems Acquisition, Continued from page 15

Multimission systems developed to these concepts would have the capacity to rapidly reconfigure on the flightline to execute their next mission in roughly the time it would take to refuel/rearm.

### Reduced Support

As industry standards replace military standards in defense equipment, there will be increased availability of commercial components. Spare parts will be available, possibly, through multiple vendors and more locations. Many of these spare parts may be interchangeable with components used in other military systems, benefitting both the customer and the supplier. This interchangeability (not necessarily commonality) will also increase the amount of familiarity to technicians. The more familiar the spare parts are to the technician, the less sophisticated is the maintenance training required, which is huge advantage.

### Access to Technology

Incorporating industry standard interfaces provides affordable access to commercial technology. With modest qualification testing to verify performance, commercial technologies may be easily incorporated.

### Improved Performance

State-of-the-art system performance is readily accessible to systems employing standard interfaces. Closed systems, in contrast, will languish in obsolescence as pertinent technologies go unrealized. To tap this source of technology, system developers have to create these technology hooks. ♦

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- OSJTF Case Study of the U.S. Army's IEWCS*. November 15, 1996.
- IBID

## Note

- There may be a misperception that the Army restructured the IEWCS program due to fallacies of the acquisition strategy or some shortcoming of the open systems approach. The approach used by the acquisition team is still considered correct and the open systems approach and findings are valid.

- CMU/SEI-93-TR-25, *CMM Practices*.

## Acknowledgements

The author thanks Robert Lewis and Rodney Tuten of the Naval Surface Warfare Center (Dahlgren, Va.), and John W. Guthrie, Thomas Blackwell, and Mark Sullivan of EG&G Technical Services.

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# Taming the Cyber-Frontier: Security is Not Enough!

Paul Toscano  
*USERTrust Inc.*

*A major problem in cyberspace is the lack of security, privacy, and integrity in the creation, collection, transmission, processing, storage, and use of electronic and digital information. Before users fully adopt e-business enabling technologies, they will consider the total context of what is required for them to feel safe in the virtual world. Security alone will not be enough. In addition, users will require all aspects of informational privacy and integrity through data vaulting and trusted third-party data management in order to feel as safe with e-business as they now do with paper transactions.*

The cyber-universe, like the real universe, is expanding. Functions, applications, and usages grow daily as more people become computer literate. Since the early 1950s, the real world has become more reliant upon the virtual or cyber-world. With the Internet and wireless communication, a vast amount of messaging and commerce is now taking place globally at virtually light speed—although it does not always seem that fast.

Currently, cyberspace is still very much a frontier—just as America was in about 1650. It has only recently been colonized by ordinary people who followed in the footsteps of those intrepid cyber-explorers who built ARPAnet, the Internet, and the World Wide Web. Life in cyberspace for its early settlers is promising, but hard. Although technological mountain men thrive in this environment, the less able can find life there ineffectual or worse; it can be nasty, cruel, brutish, and short.

In spite of this, the population of cyber-settlers is growing exponentially. Cyber-colonists sense the cyber-frontier's untapped resources. They intuit its opportunities. Many of them also harbor anxieties about its risks and dangers; yet, they continue to make forays into the unknown. They quarry out habitations, establish networks, create enterprises, and engage in commerce. Much of this is taking place without any settled assurances of security, privacy, or integrity with respect to the collection, transmission, storage, and use of electronic and digital information.

## The Problem

One of the chief strengths of cyberspace is that it transcends the borders of states and nations. This is also one of its chief weaknesses. Because the cyber-frontier is not subject to the laws of any one country or jurisdiction, laws regulating cyber-transactions do not exist. Where they do, they are not standardized and uniformly enforceable and, therefore, do not have the dignity or effect of true laws. They are more like customs or norms. They are usually drafted or promoted by private parties or groups from differing traditions. They seldom share similar objectives and outcomes, and often conflict. They tend to be self serving rather than self regulating. They are more likely to inspire competing rules than compliance. And whatever compliance there is cannot be reliably verified.

For all these reasons, security, privacy, and integrity of information and transactions in the cyber-frontier are available only to a small minority and only in restricted cyber-communities (usually either governmental or commercial intranets or extranets) where authority structures have been established and are managed according to uniform policies, procedures, proto-

cols, and practices. Outside these communities, cyber-citizens are on their own for the most part. Or else, they must rely on experts offering partial solutions for commercial gain.

The thorniest problem hindering the entire cyber-frontier is the lack of security, privacy, and integrity in the creation, collection, transmission, processing, storage, and use of electronic and digital information. Like the wild, wild west (another WWW), the cyber-frontier needs to be tamed. But unlike the citizens of the wild west, cyber-citizens cannot rely on a local sheriff or a federal marshal to bring order out of chaos. Because the cyber-frontier overlays many nations, cyber-rules and laws cannot be created or enforced effectively by any one government. "Who is going to perform this mediating function?" is a recurring question that so far has no satisfactory answer. Any government seems disabled by its inability to enforce order beyond its jurisdictional limits; moreover, for-profit companies are disqualified by the profit motive, which encourages them to tip any level playing field in their favor, making it easier for them to create wealth for their shareholders.

To date, there is not even a workable consensus on what security, privacy, and integrity of information actually mean, let alone on how these values can be preserved in cyberspace.

## What Will It Take?

In the balance of this paper, I would like to propose a working definition of terms and to provide a suggested list of minimal requirements necessary for cyber-citizens to enjoy the same informational security, privacy and integrity in the virtual world that they have come to expect in real world paper transactions.

In the computer industry the term *security* means something different to non-experts than it does to computer experts. To non-experts, security means that a user's data transmissions and transactions are safe. *Safe* implies to the layperson that electronic and digital information is: safe from technological failure, hackers, loss or corruption; safe from prying eyes; and safe in the sense that it will be available and reliable in the future. For non-experts, security not only means data protection, it also means data privacy and data reliability or integrity.

To the expert, however, security may or may not include informational privacy and integrity. An expert may consider a transaction secure if the data in transition flowed through a secure channel—even though the source of the message is uncertain, the recipient's identity cannot be assured, and the message itself can be read by any party who can capture it. An

expert may consider information in a database or data warehouse to be secure if it is protected by firewalls and managed according to acceptable security standards—even though the data consists of the personal and sensitive information of parties who have no knowledge or control of how the data was collected, is processed, or will be used. For non-expert users to have confidence in the enabling technologies of e-business, they will consider the total context of what is required to feel safe. In doing so, they will conclude that security is not enough.

## Working Definitions

*Security* refers, at a minimum, to three different protections. First, security refers to any protection that enables electronic and digital information to be transmitted from a known source to an intended recipient only. Second, it applies to any protection that enables such information to be stored, transmitted, processed, or used without compromise, alteration, or corruption. Third, security refers to any protection that enables such information to be linked to any real world person whose identity has been reliably authenticated and represented by a verifiable cyber-identity, such as a digital certificate, digital signature, or other electronic ID.

*Privacy* is a bit more challenging to define. Currently, there is no universally accepted definition for privacy or for informational privacy. Seeking a normative definition—that is, one that defines privacy in terms of what normally should be kept private—does not work because people from various cultures cannot agree on what should be kept private. (This is clear to any American who has visited the beaches of southern Europe.)

I propose an analytical definition—one based on an analysis of the recurring elements essential to privacy regardless of what is being kept private. Take land, for example. To establish private property, it must first be separated from the surrounding property. Then access must be restricted. Finally, the land use must benefit only its owners or a tenant with the right to occupy, farm, or mine the property.

What is true of land use is also true of any property, including bodies of information, whether electronic or otherwise. Informational privacy depends on (a) separateness (b) restricted access, and (c) beneficial use. In discussions of informational privacy, little is said about these essentials—probably because they are so fundamental they are left unaddressed as unstated assumptions. Let me review these briefly:

(a) Separateness. Before a legitimate claim of informational privacy can be sustained, the information in question must be rendered separate and identifiable. This involves the process of partitioning the data. Until this takes place, there is nothing to which a claim of ownership can attach. Once partitioned, privacy requires that a claim of right in the separate data be asserted. This claim of right can be a claim of ownership or a claim of use. In either case, the claim must be grounded in law—that is, the claim must be one the law recognizes. For example, a claim of ownership in data may be based on an author's common law copyright or on a publisher purchase contract. Or it may be based on inheritance, lease, license, or other instrument of title or conveyance.

The process of separating digital information and establishing title to it is merely a way of creating enforceable cyber-boundaries to digital or electronic information. Title to data cannot be

enforced, however, if it exists only in the mind of the claimant. It must somehow be declared, if not publicly, then at least before credible witnesses. This requires that some kind of notice be available that describes the property, the boundaries, and those with ownership or access rights to it.

**“I propose an analytical definition—one based on an analysis of the recurring elements essential to privacy regardless of what is being kept private. Take land, for example. To establish private property, it must first be separated from the surrounding property. Then access must be restricted. Finally, the land use must benefit only its owners or a tenant with the right to occupy, farm, or mine the property.”**

In the virtual world, such boundaries and claims of ownership and use can be established by companies that assure the reliability of encoded cryptography. Public and private encryption keys can now be issued to users. These public and private keys can be certified to users whose identities have been acceptably authenticated. Such users can encrypt or digitally sign data streams with these keys. They can separate and identify data streams and establish an initial claim of right to the data as its originator, owner, or user. Of course, this claim can be challenged. But at a minimum, public key encryption technology allows data boundaries to be established and title to data to be asserted in the cyber-frontier. This is an important step forward.

(b) Restricted Access. Setting legally enforceable boundaries alone does not ensure confidentiality or restrict access. Privacy is nothing unless the identified data can be protected from unwanted interlopers. Restricted access can also be achieved by the use of public key cryptography. Data can be encrypted with a person's public key so that it can be decrypted only with the corresponding private key held solely by the holder of the unique key pair. This technique will render data confidential. The problem is that it is not a reliable technique because there is only one private key in the hands of its owner. If that key were lost, stolen, or damaged, then the encrypted information would remain virtually irretrievable. This is not a very attractive prospect, especially in a commercial environment where documents are vital.

However, it is not a solution to make a copy of a private key and put it in a safe place. This approach, referred to as private key escrow or management, creates significant security risks. The private key is a digital signature. Under current law, if a private key is used to sign a digital document, that digital signature is considered binding. If a private key is copied to a floppy disk, for example, it could be stolen and used to create legally binding documents without the knowledge or authorization of the owner of the private key. If the private key were put in escrow with an agent, the agent or an employee of the agent might compromise the key or use it improperly. What is more troubling, the private key owner could allege that his or her digital signature was used without authorization and thus repudiate the enforceability of a digital signature to avoid obligations under an electronic contract.

For these reasons, confidentiality and restricted access to cyber-information is not reliably achieved by encrypting data

with a public key. A better method of assurance is needed—more about this later.

(c) Beneficial Use. In addition to the separate and restricted access to data, there must also be a means to insure that only data owners or authorized parties receive the benefit of such information. When it comes to real estate, we understand that a residence is not private if anyone can live there. Electronic information is not private if anyone can see it, use it, or benefit from it. A contract is useless if any non-party can claim its benefits or avoid its burdens. An essential element of privacy, then, is beneficial use (or proprietary utility).

To assure beneficial use means to assure that data is accessible, readable, and useable only by authorized parties and in spite of technological advances or obsolescence. To achieve beneficial use requires data vaulting. Information, such as e-contracts, personal identifying information, or sensitive medical or legal information, must be preserved so that it will be available to authorized parties in the indefinite future. To achieve this end, digital document signatures must remain identifiable and legally binding. Document form and content must be rendered persistent. A document's admissibility as court evidence must be assured. A record must be kept of the source, date of origin, history, and chain of custody of the document together with the identity of its owners and any parties with authorized rights of access and use. In addition an auditable record of access and retrieval must be kept to prevent confusion and maintain record chronology.

Without these safeguards, users have no assurance they will receive the beneficial use of the information and obligations memorialized in their digital documents. Without these assurances, users will be reluctant to bring their paper process on line. Hence, they will not reap the cost savings, gains, and other benefits of the Internet, the World Wide Web, or wireless communications systems. This is especially true for professionals in the legal, health care, accountancy, real estate, lending/leasing, and intellectual property industries—professionals with a duty to protect the confidences and secrets of their clients or patients.

*Integrity* is the third assurance the cyber-frontier needs in addition to the three security protections and the three elements of privacy discussed. Informational integrity refers to the retention of data and documents according to rules that ensure their preservation in a trustworthy environment so they will continue to serve their intended purposes. Integrity means that personal data will remain personal, sensitive information will remain confidential, and legal documents will remain enforceable. Informational integrity in cyberspace is achievable only when digital and electronic information is securely retained in the possession of trusted third-party custodians.

The most troubling problem plaguing the cyber-frontier is the retention of data by non-neutral, biased, interested parties. User information is typically warehoused with digital database services offered by for-profit companies. These companies are run by management teams and boards of directors whose overriding duty is to their company shareholders, not to the data owners. A subscriber to such a service places personal, sensitive, legally significant, or valuable proprietary information in the care of companies whose self-interest may conflict with the subscribers' interests. Even when such companies sign contracts promising to pre-

serve subscriber privacy, the underlying conflicts of interests together with the pressures of undue influence and the profit motive still exist. This is not an environment of trust in which the security, privacy, and integrity of information can be guaranteed.

Informational integrity requires data custodians to be neutral, even handed, independent, and free from disqualifying conflicts of interests. Informational integrity can be assured only when it is in the safekeeping of trustee-like custodians who have only one duty—to apply fair information practices in order to preserve the original form and content of information so that it will continue over time to serve the purposes for which it was created, collected, stored or processed. Only such custodians can reliably certify a traceable and auditable document registry, provide a reliable chain of custody, or assure the evidentiary integrity of documents.

## Legal and Technical Requirements

The cyber-frontier must be tamed; however, security is not enough. What is required is full informational privacy consisting of all the aspects of security, privacy, and integrity discussed here. Without full informational privacy, individual autonomy cannot exist in cyberspace. Individual autonomy is the prime value of an open, democratic society and should never be sacrificed on the altar of expedience, digital or otherwise.

What is desperately needed to tame the cyber-frontier is a neutral, independent, nongovernmental, self-regulatory architecture of privacy that can assure data originators, owners, and users of 12 legal and technical requirements:

1. Data can be rendered separate and identifiable.
2. Data ownership and access rights can be identified and registered.
3. Data will not knowingly be viewed, altered, intercepted, copied, confiscated, or divulged without authorization of its owners.
4. A person's digital likeness will not be appropriated.
5. No intrusions upon a person's solitude or seclusion by eavesdropping on digital or electronic communications, or sending unwanted communications will be tolerated.
6. No information that puts a person in a false light will be disclosed.
7. Personal and sensitive information will be collected, stored, processed, retrieved, and used only according to prepublished fair information practices.
8. Data management risks and liabilities will be kept at a minimum.
9. Data owners will maintain control of their own personal and sensitive information.
10. A reliable, auditable record of data will be kept and its chain of custody will be maintained for certification to authorized requesting parties.
11. Data owners and authorized users will be identified by acceptably authenticated and certified cyber-IDs.
12. ID authentication and certification, with personal, sensitive, confidential data collection, storage, processing, retrieval, and usage will be managed by private, unbiased, third-party fiduciary custodians with an unconflicted duty to data owners or authorized parties.

## Conclusion

The cyber-frontier must be civilized in order for cyber-citi-

zens to feel safe. They must be confident that informational security, privacy, and integrity will be ensured. Internet, World Wide Web, and wireless communication must be preserved as an open and level field for all. There must, however, be introduced a private, trust-based supra-jurisdictional architecture, consisting of neutral third-party protective custodians. These custodians serve in the place of government to act without bias, undue influence, or profit motive to assure the even-handed administration of fair information policies, procedures, protocols, and practices. This will enable the delivery of informational security, privacy, and integrity to a global community in desperate need of end-to-end reliability of the digital transactions that form the basis of cyber-relationships of all kinds.

When these essentials are available to all cyber-citizens on an equal footing, then we will have tamed the cyber-frontier. We also have the opportunity to move at Internet speed to adopt the technologies, definitions, trust structures, and legal processes that are indispensable to individual freedom, personal autonomy, a free market, and the pursuit of e-business worldwide. ♦

### About the Author



**Paul Toscano, M.A., J.D.**, is the executive director of The USERTRUST Network LLC, a public key infrastructure that provides encryption products and fiduciary repository to facilitate worldwide e-commerce. Since 1997, Toscano has developed legal/technological structures that safeguard informational privacy in electronic and digital transmissions through public key encryption. Previously he was an attorney focusing in the commercial arena, specifically in cases dealing with insolvency. Toscano has published several articles and a book on first amendment freedoms.

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## Letters to the Editor

Dear Editor:

Somehow I doubt that the quote attributed to Thomas J. Watson in your August issue on p. 21 [*Quote Marks*] occurred in 1965. At that point IBM was in the throes of the development of System 360. I doubt IBM would have undertaken that effort for the sale of five computers. I suspect the actual year of that quote was much earlier, maybe 1935 or 1945. Also, it appears to be attributed to Watson Sr. rather than Watson Jr., making it almost certainly much earlier.

Dr. Nancy R. Mead  
Senior Member, Technical Staff  
Networked Survivable Systems Program  
Software Engineering Institute, Carnegie Mellon University

**Ed. Note:** *You map out good historical parameters Nancy. Watson Sr. did make this statement in 1949.*

Dear Editor:

I am currently completing my master's in software engineering from the University of West Florida (UWF). My directed study this past summer was to rewrite the process for the graduate software engineering project class. We used a defined software maintenance process to teach software engineering. Class members assumed roles (management, SCM, SQA, SEPG, Metrics, and engineers) and we maintained and enhanced a software tool developed at UWF.

It was a great class, and we all learned a lot about working with in a process. The majority (95 percent) of the students are military or contractors involved with some sort of software or hardware development. A lot of different experience is brought together and information is shared about better ways to achieve the goal.

I have referred to CROSS TALK on many occasions and always have found something new and interesting. I will continue to be interested in this area of technology. My company (TYBRIN Corp.) is CMM Level 3, pushing towards level 4, and beginning to get the information concerning CMMI. I was very interested in the latest issue of CROSS TALK for that information. Keep up the great work!

Darsi D. Ewing  
TYBRIN Corporation

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# Using Your Software Coach Effectively

John B. Hubbs

*Coaching is fast becoming the most effective management tool of 2000 in many business areas. With staff shortages and insufficient mentoring skills available, coaches fill a void by assisting Information Technology (IT) managers at all levels.*

Recent articles in *CIO* [1] and *Fortune* [2] describe cases of coaches assisting IT clients with a variety of career concerns. A Web search on “coaching” provides hundreds of hits on articles and resources that need to be narrowed for a specific purpose. Four years ago *Fast Company* [3] magazine chronicled the success of coaches to prepare staff members to take the next step or learn how to be more successful in their present positions.

Some firms (e.g., IBM and Ernst & Young) have in-house coaches on their staffs. These companies see the value of working one-on-one with personnel to either improve performance in existing positions, prepare selected individuals for new positions, or (rarely) transform the client by reframing how they approach work—and life—situations. Other firms retain outside coaches to work with the individual to achieve the same results. Both types of coaches build trust through a confidential relationship that involves careful listening and aggressive questioning whereby the client arrives at the optimum solution that they own. Regardless of how the coaching agreement is initiated or structured, the bottom line is that all coaching is personal.

Despite the growing popularity of coaching, many IT executives are unclear how it differs from various types of human relations consulting. The objective of coaching is to leverage the individuals’ strengths to broaden their base rather than to teach them new skills or retrain them to overcome weaknesses. Coaches operate on the assumption that the clients know the solutions that will work best for them, if someone can guide them to uncover the answers. The consultant model is usually based on prepackaged solutions that worked elsewhere. These solutions are rarely long lasting because the client does not feel ownership of the solution. The consultant’s job is done when the package is delivered. Coaches are skilled at listening followed by later questioning that leads the client to uncover the best solution that is pursued with enthusiasm. Permanent change of the client is the primary gauge of a coach’s success.

The following notional examples of how to use a software coach are valid for most positions or scenarios. They are presented as typical situations found in IT and other industries.

## Chief Information Officer

This position has become one of the loneliest in an organization. An effective chief information officer (CIO) must provide knowledgeable support to his or her staff as well as encouragement plus set the best example in a department that is critical to the success of the enterprise. A coach can assist the CIO in this role by guiding a clear definition of the most pressing issues and leveraging IT resources to delegate other difficulties.

Janet Trombley was a successful chief financial officer of a sizeable manufacturing firm and an experienced user of IT services. Somewhat reluctantly, she accepted senior management’s

offer to assume responsibility as CIO. She was caught in a not uncommon dilemma. Without an IT background, she found sizeable gaps above and below her. Corporate managers expected her to be able to respond to their requests for IT services as adroitly as she had their financial needs. Meanwhile, the analysts and programmers reporting to her were speaking in terms that were quite unfamiliar. This dual gap situation is the most challenging for a coach. With her coach, she prioritized the issues and approached them with confidence.

Trombley’s most pressing concern was that other executives in the firm misunderstood the nature of software and how it is produced. Her coach helped her leverage her current skills to define an approach to bridge each knowledge gap of the senior management staff. Through a consistent program of interpersonal communication, Janet was able to share her learning experience with her peers and managers to allow them to appreciate the nuances of developing and maintaining systems.

The other major problem facing all CIOs is simply too many demands and too little time to satisfy them. With her software coach as champion and guide, Trombley was able to develop and enhance her skills at prioritizing and delegating. Together they isolated those issues that only she could resolve and identified the appropriate managers to handle the others. Delegated problems were actively tracked to closure.

## Development Manager

Fred Johnson had developed and installed several systems over the years. As the manager of development, he found that the old carrot-and-stick methods he was accustomed to were not working. His software coach listened carefully to his success stories and assisted him in applying the lessons learned to developing long-term skills for excellent performance.

As system development manager, Johnson had trouble keeping the teams motivated. By drilling down with aggressive questions, his coach helped him create a self-generating practice for pragmatic results. She allowed him the freedom to try out different options and weigh their merits in a confidential, supportive environment. She was careful to not pass judgment, but continually challenged him to explore alternative outcomes until he discovered a solution he knew would work for his teams. Rather than just managing for results, Johnson turned to maximizing the strengths of each employee or training them to overcome a weakness. His teams now set what were previously considered audacious goals and frequently beat them.

During this process Johnson discovered some personal habits that he learned were self-defeating. He frequently finished other people’s sentences and inserted “you know” into his speech. His coach encouraged him to listen carefully and explore different ways of interpreting his day-to-day experiences, personally and

professionally. As a result, he is much more confident and effective as a manager as well as member of his family and community.

## Process Improvement Team Leader

When Susan Perkins was tapped to lead the software process improvement team for a developer in the Midwest, she was shocked. She was unsure how to proceed with the assignment much less how to obtain the results management expected. She was working with a personal coach prior to the assignment; he helped her find a coach with experience in software process improvement. Her new software coach served as a guide and mentor regardless of the model (Capability Maturity Model, International Standards Organization, or military standards) that her team needed to employ.

Perkins' major concern was that the new team was functioning at less than optimal production. With her coach, she discovered a previously unrecognized ability to foster mutual respect, trust, and freedom of expression of the process improvement team. The results in measurable output from the team were significant. Rather than pushing for action and responsibility from the team, she shifted to creating an alliance around the vision of well-defined processes.

The challenge of any process improvement team is preparing the users of the new procedures for the culture shock of a new way to develop systems. Perkins asked her software coach to assist the team with developing the skills to minimize impact of change. They learned to embrace the grieving cycle (denial, anger, bargaining, depression, and acceptance) and extend it to accelerate the productivity improvements of the new processes. Lewis Gray's model in *CROSSTALK* [4] was enhanced with a new sixth stage of change—ownership of the results following acceptance of the change.

## Data Center/Network Manager

The other lonely IT job is the manager of a data center or large client/server network. All that George Jensen heard were problems and complaints. Little recognition was provided to the last in line of the IT process at a large government agency—leaving him feeling powerless and unmotivated.

When Jensen's manager informed him that he would be working with a coach retained by the personnel department, he was skeptical. The coach's first task was to win his trust by assuring him that *everything* transpiring between them would remain confidential. Not until his manager and personnel representative agreed to this policy, and after a few coaching sessions, did the coach earn his confidence.

Jensen knew that he had trouble expressing his thoughts and ideas, which were often quite insightful—just poorly presented. His coach provided him with alternative ways of expressing concepts and supported him with trying new language techniques. By assessing the alternatives in a non-judgmental setting, he developed latent communication skills that prepared him for the next step of his promotion plan.

For the past two years, Jensen had wanted a different job with more responsibility. While working with him on the communication skills, his coach noticed several habits Jensen did not want to deal with at first. The coach guided his client through a process of discovering how his demeanor interfered with achiev-

ing his goals. With the confidence of presenting his ideas clearly came the desire to focus on these other behavior patterns. Rather than criticize the actions of others, he learned how to ask well-focused questions that achieved the desired results without offending. Now he is on a path for a promotion in the agency.

## Conclusion

Coaches develop a partnership with their clients that is based on trust and confidentiality. Although most publicized coaching examples present cases of senior executives, this new emerging management tool is effective at any level in the organization. With mentors in short supply, especially in the software industry, coaches can help managers at any level improve and grow.

Ask successful associates—you may be surprised who has a coach they are willing to refer. Finding the right person is the first step in effective use of your software coach. ♦

### Look for Coaching Credentials

Coaching suffers from many of the same problems encountered with any new field of endeavor. Presently, people can declare themselves a coach with or without training. Finding the right coach involves a search to ensure the chemistry is right for the client. Coaches are trained at several reputable institutions that provide extensive and rigorous instruction programs. Whether the students have a background in psychotherapy or software engineering, they must complete the regimen offered by organizations such as:

- Coach University, 800-48COACH, [www.coachu.com](http://www.coachu.com)
- Coaches Training Institute, 800-691-6008, [www.thecoaches.com](http://www.thecoaches.com)

Accrediting organizations are available to assist clients with finding professional coaches. These include:

- International Coach Federation, 888-ICF-3131, [www.coachfederation.com](http://www.coachfederation.com)
- Professional Coaches and Mentors Association, 562-799-2421, [www.pcmaonline.com](http://www.pcmaonline.com)

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### About the Author



**John B. Hubbs** has more than 20 years of software engineering and process improvement experience. He is the author of *The Upside of Y2K*, *CROSSTALK*, February 1999, and maintains a positive approach to software engineering and process problems. A member of the International Coach Federation and an affiliate of Coach University, he coaches from his Maryland home.

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# Acquisition Reform May Resemble Madness, but the Method is Real

Jim Belford

*Science Applications International Corp.*

*Acquisition reform opens the door to innovative thinking and creative teamwork. Leaders have taken advantage of this in ways that at first glance appear drastically different from the norm. Jim Belford learned this when he acted as technical advisor for the CROSS TALK team interviewing leaders of missile programs at Eglin Air Force Base, Fla.. However, upon deeper investigation he found familiar process methods at work.*

There has been considerable debate over the merit of current acquisition reform initiatives. In this issue of CROSS TALK two major programs, the Joint Air-to-Surface Standoff Missile (JASSM) and the Advanced Medium Range Air-to-Air Missile (AMRAAM), were presented that demonstrated a significant return by applying innovation to the way they acquired weapon systems. The common thread seemed to be developing accurate functional requirements, selecting a capable contractor, empowering the contractor, and obtaining a bumper-to-bumper warranty. The focus was on product rather than process. The results were impressive to say the least.

**“Process maturity helps to ensure repeatability, and a contractor assessed at Level 3 or higher will have institutionalized processes, which assures repeatability ...”**

We need to keep in mind the old adage, “An ounce of prevention is worth a pound of cure.” Mature processes facilitate and are essential to the success of the current acquisition strategies that have resulted from reform initiatives. Both Lockheed Martin and Raytheon, developers of JASSM and AMRAAM respectively, place a high regard on process improvement. Companies throughout Lockheed Martin have recognized the importance of software development excellence and strive for highest software process maturity—Federal Systems at Oswego, N.Y., achieved Level 5 using the Software Engineering Institute’s Capability Maturity Model® (SEI CMM) in December 1997. JASSM was one of three programs used in December 1998 to certify Lockheed’s Missiles and Fire Control Company at SEI CMM Level 3. Seven other programs were introduced in 1999 to insure institutionalization of the processes.

With respect to JASSM, Terry Little, program manager, stated, “We have ... had absolutely no problems with software. We are ahead of schedule in software development, and it is a fairly formidable program because it involves not just the missile’s operational flight program, but the seeker algorithms, ... and a whole different set of software related to the mission planning.”

Raytheon has also demonstrated a high level of proficiency with respect to software development. Raytheon Systems Company’s Command and Control Division achieved SEI’s highest rating, CMM Level 5, in January 1998. Raytheon Missile Systems, Software Engineering Center, Tucson, Ariz., achieved SEI CMM Level 4 in October 1998. This places both companies among the elite with respect to software development.

## Contractor Holds the Key

Selecting the right contractor is the key to success in this era of innovative acquisition strategies. Both Little and Judy

Stokley, AMRAAM director, stressed the importance of past performance in selecting a contractor. The Defense Science Board Task Force on Software stressed the importance of both past performance and process maturity as key considerations when awarding a contract. Is there a connection between past performance and mature processes? I believe there is.

Process maturity helps to ensure repeatability, and a contractor assessed at Level 3 or higher will have institutionalized processes, which assures repeatability regardless of which organization within the company does the work. Repeatability also supports predictability resulting in more accurate estimates of the effort required (cost and schedule) to deliver a product. Stokley stated, “I think of process improvement more as an attitude that we motivate industry with ... to keep this [AMRAAM] a healthy viable product that meets its requirements and is affordable.”

In addition, for acquisition reform to be successful the acquirer must also use sound processes when initiating a business relationship. It is the acquisition organization’s responsibility to select a vendor that is capable of delivering a product that meets the stated performance specification, on time, and at cost. To accomplish this, as a minimum, processes must be in place to communicate requirements in an unambiguous manner, ensure contractor capability, verify cost and schedule estimates, and track metrics that impact the program (schedule, expenditures, etc.). These processes are as significant as those used by the vendor to develop mission critical software.

It is my opinion that process maturity provides the foundation for success in today’s acquisition reform arena. Innovative individuals such as Stokley and Little provide the leadership that bring all of the players together as one team to make it happen. ♦

## About the Author



**Jim Belford** is a senior systems engineer with Science Applications International Corp. He works in the Computer Resources Support Improvement Program office, Hill Air Force Base, Utah, providing technical and business management support. Belford has 13 years experience in the development and acquisition of software intensive systems. He has a master’s degree in business administration (technology management) from the University of Phoenix, a masters in computer engineering from the Air Force Institute of Technology, and a bachelor’s degree in electrical engineering from California State University.

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**FALL CLEANING OF BACK ISSUE(S)**

OUT WITH THE OLD TO MAKE ROOM FOR THE NEW  
 (AS MANY AS YOU WOULD LIKE, FREE TO YOU!)



**Time to Stuff the Tower, I Mean, Turkey**

It is almost that time of year—the time when we express our thanks for all the comparisons between turkeys and computers.

Speedy processing of the birds allows our nation to feed its annual tryptophan addiction. Speedy processors (plus ample RAM) allow our nation to fuel its addiction to software (among other things).

Everybody loves lunch meat, unless home cooking is consistently available. The same can be said of commercial off-the-shelf software. Now if we could just find the equivalent of leftover turkey sandwiches in software—hand-picked and custom-built.

If you do not cook the turkey long enough, salmonella is a danger. If you do not scan your network well enough, viruses may appear. A good antivirus program is like an accurate pop-out thermometer (in other words, an oxymoron).

If the bird is not raised properly, it may contain parasites, as poorly developed software may contain bugs. Free range turkeys, like open systems, are gaining in popularity; nonetheless, they will never overtake Butterball and Microsoft, respectively.

Grandma's secret stuffing recipe may seem like proprietary systems. Do not remove the giblets until you defrag the hard drive.

Vegetarians at Thanksgiving are like those annoying, younger tech support people who think they know more than you do. Neither turkey wire nor a clever password can keep them away.

The carver of the turkey is like the network administrator, but there is always some guy who grabs a turkey leg and walks into the other room with it as if it were a palm pilot.

Then there are the guys sitting in the front room not doing any work. All they do is sit there and watch football, dreaming of the six-legged turkey. They may as well be surfing the Net or playing Minesweeper (or that cool 3-D pinball that comes with Windows 2000. A friend of mine likes to play it ...) on company time.

Isn't it interesting that as integral as football has become with Thanksgiving, that the NFL only serves up two choices Dallas (Wintel) and Detroit (Apple). Somebody has his thumb on the lazy susan.

Whoever is in charge of leftovers is akin to a configuration manager—there is only so much that will fit into the refrigerator, and it must be labeled properly.

Were the Zip disk and Ziploc disposable tupperware invented simultaneously? That hardly seems like a coincidence. It must be some sort of conspiracy fueled by the product-line approach and factory farming.

When you sit down in front of the platter or platform, what whets your appetite? Is it white meat? Are you a GUI (graphical user interface) kind of guy? Or is it dark meat? Are you a chode (Gen X slang for *nerd*) for code? [I realize I am rapidly running out of comparisons here, as I intend to run out of room in my stomach on Thanksgiving. I intend to continue eating past that point, however.]

Despite the meat of the matter, most of us consumers and users are like turkeys with their heads cut off. We are won over by bells and whistles. A Thanksgiving spread no matter how impressive it is, would not be the same without those little extras: cranberries and gravy. And the pie is not bad either, even if it is a pumpkin-reuse project left over from Halloween.

Folks, pity the poor turkeys, who must feel like some of those pre-IPO dot-coms right before they go public.

Thanksgiving holds the record for the fastest forgotten holiday. It is a race to see if the last piece of pie will get past your palate before the Christmas decorations and music break out. Thanksgiving memories last about as long as that dot-com you saw in that non sequitur commercial at halftime or the pre-eminence of your *leading edge* processor speed.

*Matt Welker and Gary Petersen, Shim Enterprise Inc.*



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